RAILROAD GAZETTE

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Contributions.

Overhead Heating.

NEW YORK, April 20, 1889.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In looking over a back number of your journal a discussion of the merits of overhead or side heating for shops calls to mind the heating of the great bridge shop of the Edge Moor Works. This is heated by coils placed directly under the roof. Steam is run freely through the coils and tests of the pressure in the pipes have rarely shown as high a tension as atmospheric pressure. The return pipe ends in a hot well, from which the boilers are supplied. The heating is reported as eminently satisfactory. No ventilation is used except the frequent opening of the grate and doors.

W. HOWARD WHITE.

Accounting for Equipment Worn Out.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In the purchase of a railroad and its effects, among other things and equipment there were 100 old box cars, the valuation of which was placed at that time on the books at $300 each, or $30,000 in total. These cars are still held in account at the same valuation, but have become useless and are held on side tracks, being kept entirely out of service. They are, however, represented in the company's equipment, and come under the general mortgage. The question is, how to adjust the accounts in case they are pulled to pieces, and also how are the trustees under the mortgage to be satisfied? Must they be replaced by new cars, and if so replaced, how should the excess cost over the value of the scrap from old cars be charged out? Q.

[The value of the assets borne on the equipment account must be made good, and $30,000 worth of rolling stock must be substituted for the cars worn out. From the point of view of the railroad accountant, it is immaterial whether this be made up of 100 new cars worth $300 each, or 75 cars worth $400 each; but the consent of the trustees under the general mortgage would doubtless be necessary in the latter case. The excess of this $30,000 above value of scrap must be charged to profit and loss, just as if there had been a re-valuation of assets; as indeed there virtually is, when cars which have stood on the books at a fictitious value are sold for old material.—EDITOR RAILROAD GAZETTE.]

Relative Economy of Cars of Small and Large Capacity.

CORVALLIS, Or.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In a recent discussion regarding dead weight in train loads a railroad man high in position and of at least 30 years experience, asserted that there was no gain in moving freight in cars whose carrying capacity is 15 tons over those carrying 10 tons, the weight of each car being practically the same, viz.: 15 tons. As I am a mere tyro in the profession and had no figures in hand to back me, I could only answer assertion with assertion. My proposition was that, supposing an engine could haul in 15-ton cars 300 tons freight, the total weight of train would be 600 tons, requiring 20 cars.

In 10-ton cars I contended that only 240 tons freight would be hauled by the same engine in 24 cars, making total weight of train also 600 tons. In addition to this 20 per cent. in favor of the 15-ton cars, I suppose that while the friction of axles and wheels is largely in proportion to the weight carried, still there would be a percentage in favor of 80 pairs of wheels and axles, as against 96 pairs, especially on track with considerable curvature.

We railroad men learn as do children, line by line, forgetting nearly as fast as we learn; therefore if you will repeat in a condensed form the deductions from experiment and observation in this direction, you may enlighten not only some older men, but certainly one young GREENHORN.

[Comment upon this communication will be found in the editorial column, and while the answer there given is not direct, yet we think our correspondent can safely assume that the figures for the approximate comparative resistance per ton of paying load in 40,000 and 60,000-lb. freight cars, carrying the same total load, are correct in a general way, and analogous to the results that would be obtained if the hypothetical case he mentions was to be made a practical one. Deductions applicable to the dimensions which our correspondent cites are so far from the conditions of actual practice, that we have assumed as nearly as can be correctly done the conditions which are obtained in every-day railroad operation.—EDITOR RAILROAD GAZETTE.]

Vacuum in Locomotive Smoke-boxes.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Could you inform me of the amount of vacuum produced in smoke extensions by the exhaust steam when the engine is doing the maximum amount of work?

What vacuum would create draught to produce the maximum amount of heat from fire, bituminous or anthracite coal as fuel?

I do not know that these questions can be answered, but any information you may have would be of great service to me. W. H. ARNOLD.

[The information on this subject is quite meagre, and owing to the great diversity in the results obtained, no accurate conclusions can be drawn or formally given which will allow one to determine, without experiment, the vacuum in any particular case. Last fall Mr. George Gibbs, Mechanical Engineer of the Chicago, Milwaukee & St. Paul, made some experiments with a view to determine the amount of vacuum in locomotive smoke-boxes under various conditions, but owing to the approach of cold weather and the increase of business the experiments were not completed. However, he has kindly sent us the available information from which we have made extracts, as represented by the table. Some experiments have also been made upon the Chicago, Rock Island & Pacific by Mr. C. H. Foster, Mechanical Engineer. The results of these experiments have been extracted, and appear also in the following table. The results are for an eight-wheel passenger engine, with 18 × 24 cylinders. The boiler pressure was 150 lbs., and diameter of exhaust nozzles 3¼ in., double.

Horse-power from indicator card.	Grate area. Sq. feet.	Fuel.	Speed. Miles per hour.	Speed. Revs. per minute.	Cut off in inches.	Vacuum in ounces.	Remarks.
.....	.....	.....	54	260	6	3.2	Throttle fully open. Extension smoke-box. Diam. of stack inside = 18″.
.....	.....	.....	60	280	6	3.5	
.....	.....	.....	60	280	10	6.4	
.....	.....	.....	.....	180	10	4.6	
.....	.....	.....	.....	230	14	6.9	
.....	.....	.....	.....	280	20	3.5	
750	17	Poor quality bituminous coal.	.....	250	8	3.0	Short smoke arch.
460	17	Poor quality bituminous coal.	.....	200	6	1.3	
650	17	Poor quality bituminous coal.	.....	265	6	1.25	
440	17	Poor quality bituminous coal.	.....	215	4	1.13	
730	17	Poor quality bituminous coal.	.....	315	6	2.9	

At starting from the station the vacuum in the smoke-box averaged about 3.5 ounces. This is with the reverse lever well down in the corner, the engine running at very slow speed. The best results of firing were obtained with about 3.5 ounces vacuum. When the vacuum exceeds 5.8 ounces it is difficult to keep coal on the grate when the fire is thin. It is at this pressure that the fire is torn to pieces by the excessive draft. Three ounces of vacuum is generally sufficient to produce a satisfactory draft in the fire-boxes of large eight-wheel passenger engines.—EDITOR RAILROAD GAZETTE.]

Proportions of Locomotives.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Several years ago the writer undertook to collect the leading features of various locomotives as opportunity offered, and compare them on a systematic plan, having in view the analysis of the proportions, the formation of ratios, and, if possible, the determination of the limits between which a successful locomotive could be built, and, further, he hoped to establish proportions which could be demonstrated as representing the essential fundamental principles of locomotive design dictated by good practice and economical maintenance in actual service. Several types of locomotives running on various roads had become noted as good engines, pulling heavy trains, steaming freely and running on schedule time with comparatively few detentions caused by engine failures. It was hoped that, by comparing them all together, the good and the bad, some light could be thrown on the subject and certain formulas evolved from which locomotives of any size and capacity could be constructed. I will not here attempt to discuss more than two or three of the leading features, such as the proportions of the cylinders to the diameters of the wheels, the weight on drivers, the steam pressure, the grate area, heating surface and the tractive force.

A preliminary investigation of the subject shows that locomotive builders, railroad men especially, have widely differing opinions on these topics, and few agree on definite rules for the proportion of parts. Perhaps the manner of building a new engine at railroad shops will illustrate the difference of opinion and show the utter disregard of uniformity in practice. This development of a new locomotive is about as follows: The first detail determined is the size of the cylinders. If the new engine is to be more powerful than its predecessors, which have, for instance, 17-in. × 24-in. cylinders and 68-in. wheels and a 48-in. boiler, the new cylinder is very apt to be 18-in. × 24-in. The business on the road has, we will assume, outgrown the smaller engines and increased power is required to handle the trains on time. Reports of engine failures from one cause and another are becoming too numerous to be pleasant. One day, maybe, they won't steam; next, the boxes on pins get hot; another time, everything does not go just right—there is no margin of power to work on—and delays are caused until when, "patience has ceased to be a virtue," the remedy pointedly suggests itself, that more powerful engines are required to do the business properly, and the mechanical department goes to work to get up an engine which will "just walk away with anything running on wheels."

The size of the cylinders having been settled, the next step in order is the wheels. In this matter much difference of opinion will be met with, and they will vary in diameter from 62 in. to 68 in. according to the personal experience of the Master Mechanic or Superintendent.

The boiler is next considered: the size will probably be increased, and a few flues will be added, but owing to the fact, that the weight must be kept within limits prescribed by the road department to suit the bridges and track, and further, because the frames, axles, boxes, pins, etc. have been made larger, much increase cannot usually be made in the boiler capacity.

The size of the fire-box must be made to suit the space between the driving axles and the width of frames; therefore, unless the driving wheel base is lengthened, but little can be done to increase this detail. It will readily be seen that some "guessing" will be made in shops which only build a few engines a year and where they work them in "between times" when repairs are light. This is still more the case in those shops where only one draftsman is employed, who has, may be, for an assistant a handy apprentice boy who has picked up enough information to enable him to make a tracing. Under these conditions one may be sure that the weight of the engine will not be calculated within several thousand pounds before it is built, and some little estimating will be indulged in regarding the other proportions. The steam pressure wil be increased five or ten pounds or the safety valves adjusted to the practice of the road according to the "nerve" and the tendency of the Master Mechanic to wish for better things. The tractive force will be just what it happens to be and the relation of it to the weight on drivers the same. The success of the engine depends, therefore, much upon the shrewdness of the leading spirit engaged in her design, and whether in the various alterations in sizes of cylinders, wheels, etc., the proper combination has not become too much "mixed."

The foregoing shows why it happens that we have such a variety of locomotive proportions under what may be considered like conditions, as shown by the following comparisons: In comparing a number of locomotives built by various railroads and locomotive works, embracing the leading types of several years past, the tractive force was found to vary from $\frac{1}{3.37}$ to $\frac{1}{5.68}$ of the weight on drivers* and other essential features in like proportion. With these facts in view two questions naturally suggest themselves: (a) What is the best proportion for general service? (b) Does it matter whether any rule is followed, considering the great diversity in practice exhibited by actual use?

A committee of the Master Mechanics' Association appointed to report on the proper proportion of locomotive cylinders and driving wheels, says that the weight on drivers should be for:

Passenger engines 4 times greater than the tractive force.

* By the "tractive force" here mentioned is to be understood the power of the cylinders in pounds pull or push, on the crank pin, reduced to the point of contact of the tire and the rail when the average pressure in the cylinders is 85 per cent. of the boiler pressure.—EDITOR.

Freight engines 4¼ times greater than the tractive force.

Switching engines 4⅓ times greater than the tractive force.

The tractive force being calculated with tires half worn out and with an average pressure which is 85 per cent. of maximum boiler pressure. The report published in the proceedings for 1887 is full of information and worthy of careful perusal by those interested in this subject. That passenger engines should require more tractive force than freight or switching engines is a point the correctness of which may be questioned. Each class has, at times, to work up to its maximum power, and should have a tractive force sufficiently large to revolve the wheels on a dry rail, almost up to the limit of adhesion, when cutting off steam at full travel of valve. Any engine should be able to exert at times the greatest amount of power in the cylinders which may be necessary to revolve the drivers, when the adhesion is greatest.

It would seem that switching, or freight engines, many of which on nearly all railroads have to work at times at places where the grades are heavy, and the curves sharp; should be able to pull the utmost that the adhesion of the drivers will allow in order to work satisfactorily. The method used in obtaining the figures for tractive force, given above, was the common formula

$$\frac{D^2 \times L \times P}{W}$$ in which :

D = the diameter of the cylinders in inches.

L = the length of the stroke in inches.

W = the diameter of drivers in inches.

P = the mean effective pressure of steam in the cylinders (assumed to be 85 per cent of maximum boiler pressure).

The result is the "tractive force" of the locomotive, or the power the engine can exert at the rail. From this must be subtracted the power necessary to move the machinery of the locomotive. The weight on all the driving wheels, divided by the total tractive force is the ratio existing between them.

The total tractive force, taken on a basis of 85 per cent. of the boiler pressure, divided by the total heating surface (fire-box and external surface of flues in square feet), is the ratio between these quantities, and the total heating surface, as above, divided by the grate area in square feet, is the ratio between those factors. The following table gives some extreme limits to which locomotives in actual service have been built in this country:

	Pass.		Freight.		Switching.	
	Low-est.	High-est.	Low-est.	High-est.	Low-est.	High-est.
Weight on drivers divided by total tractive force taken at 85 per cent. of boiler pressure...	3.58	5.68	3.23	5.26	3 37	5.21
Total tractive force divided by heating surface	9.0	18.1	10.3	17.12	13.7	21.5
Heating surface divided grate area.....	14	96	15	90	59	85

If the proper amount of grate area and heating surface, suitable to the size of cylinders and drivers, can be obtained in a boiler of such size that the weight on the drivers will not exceed four times the total tractive force, and the machinery and running gear be of ample size and strength for the successful working of the engine, there would seem no good reason why the engine would not be one of maximum efficiency for the weight, whether used for passenger, freight, or switching service. In practice, however, it will generally be found, in designing an engine of a given weight—after all the wearing surfaces are made of sufficient size to give the best results, the frames, cylinders, pins, crossheads, wheels etc., properly proportioned and strong enough for economy of maintenance—that, unless great care has been taken in the distribution of the metal composing the various parts and much good judgment and skill displayed, the size of the boiler, when proportioned for what might be considered to be the best ratio of heating surface and grate area, will make the weight on drivers exceed four times the total tractive force. A passenger or freight engine with the maximum tractive power consistent with the weight, having a boiler which will not generate sufficient steam for a long run with a heavy train and ordinary coal and firing, is handicapped from the start, and stands about as much chance of being a success, as a man or horse with strong muscles but weak lungs would to win a race.

For express engines hauling heavy trains making fast time and long runs with few stops, the best practice would indicate that, for ordinary fire-boxes other than the Wootten, the size of the fire-box should be large enough to give one square foot of grate area to from 40 to 60 sq. ft. of heating surface, and that the ratio between the total tractive force and total heating surface should be from 9 to 12. The aim, therefore, under this decision, would be to have the weight on drivers in the neighborhood of four times the total tractive force. It seems, now, to be thoroughly well demonstrated that nothing is gained, but that rather power is lost, and the wear on the machinery increased, by making the tractive force greater than this, except, perhaps, the possible exception of engines working on heavy mountain grades, where a slight increase may be beneficial.

In the ordinary eight-wheeled type of passenger engine, with fire-box between the frames, about 19 or, at most, 20 sq. ft. of grate area is all that can be obtained. In large, heavy engines, where more grate area is required, the two most available methods of increasing it are (1), extend the fire-box back between the frames, over the rear driving axle, taking the place of the cast-iron foot-plate; (2), to locate it wholly on top of the frames, thus increasing the width 7 or 8 in., and putting the spring arrangement between or underneath the frames. In freight engines good practice would indicate that there should be one square foot of grate area to from 55 to 65 feet of heating surface, and the ratio between the total tractive force and total heating surface from 12, to 16, to 1.

The appended table of tractive power for various sizes of cylinders and wheels includes nearly all the different dimensions required.

In calculating the proportions of an eight-wheeled engine having four coupled drivers and a four-wheeled truck, the maximum total weight required should first be settled upon. Two-thirds of this will represent a close average for the amount on the drivers. This divided by from 4 to 4¼ is the total tractive power required; and again divided by 85 per cent. of th emaximum boiler pressure will be the coefficient of the tractive power. The coefficient of the tractive power is readily obtained from the accompanying table, suitable for any sized wheel.

If it is thought best to assume the tires half worn out, the tractive power for a wheel two inches smaller than the diameter when new, for the ordinary thickness of tires will be fonud about right for 3 in. tires. We will suppose an engine was desired of 90,000 lbs. total weight, two-thirds is 60,000 lbs. or the amount on drivers; 60,000 lbs. divided by four equals 15,000 lbs., or the total tractive power required; 85 per cent. of 160 lbs. boiler pressure is 136 lbs.; 15,000 lbs. divided by 136 equals 110.3, the co-efficient of the tractive power. The diameter of the driving wheel is 68 in. By referring to the accompanying table under the column for 68 in. wheel the figures 110.5 given for the 17 × 26 in. cylinders are the most suitable. If the boiler pressure was taken at 130 lbs., 85 per cent. of it equals 110.5 ; 15,000 divided by 110.5 equals 135.7, which is a co-efficient for about 19 × 26 cylinders. Many engines are now built with comparatively small cylinders, but large strong boilers carrying 175 or 180 lbs. steam pressure, and with proper care no particular trouble is experienced in the use of these high pressures, while the efficiency and economy of the engines is greatly increased.

C.

COEFFICIENT OF THE TRACTIVE POWER OF LOCOMOTIVES.

	42 in.	43 in.	45 in.	48 in.	50 in.	54 in.	56 in.	58 in.	60 in.	62 in.	64 in.	66 in.	67 in.	68 in.	69 in.	70 in.	72 in.	$D^2 \times L$.
16 inches × 22 inches.....	134.1	131	125.2	117.3	112.6	104.2	100.6	97.1	93.8	90.8	88	85.3	84.1	82.8	81.6	80.4	78.2	5,632
16 inches × 24 inches.....	146.3	142.9	136.5	128	122.9	113.7	109.7	105.9	102.4	99.1	96	93.1	91.7	90.4	89	87.7	85.3	6,144
17 inches × 22 inches.....	152.4	147.8	141.3	132.4	127.2	117.7	114.4	109.6	105.9	102.5	99.3	96.3	94 9	93.4	92.1	90.8	88.3	6,358
17 inches × 24 inches.....	165.1	161.3	154.1	144.5	138.7	128.4	123.8	119.6	115.6	111.8	108.4	105.1	103.5	102	100.5	99.1	96.3	6,936
17 inches × 26 inches.....	178.9	174.7	167	156.5	150.3	139.1	134.2	129.5	125.2	121.2	117.4	113.8	112.1	110.5	108.9	107.3	104.3	7,514
18 inches × 22 inches.....	169.7	165.8	158.4	148.5	142.5	132	127.3	122.9	118.8	115	111.4	108	106.4	104.8	103.3	101.8	99	7,128
18 inches × 24 inches.....	185.14	180.8	172.8	162	155.5	144	138.9	134	129.6	125.4	121.5	117.8	116.1	114.3	112.7	111.1	108	7,776
18 inches × 26 inches.....	200.6	195.9	187.2	175.5	168.5	156	150.4	145.2	140.4	135.9	131.6	127.6	125.7	123.9	122.1	120.3	117	8,424
19 inches × 22 inches.....	189.1	184.7	176.5	165.4	158.5	147.1	141.8	136.9	132.3	128	124.1	120.3	118.5	116.8	115.1	113.4	101.3	7,942
19 inches × 24 inches.....	206.3	201.5	192.5	180.5	173.3	160.4	154.7	149.4	144.4	139.7	135.4	131.3	129.3	127.4	125.6	123.7	120.3	8,664
19 inches × 26 inches.....	223.5	218.3	208.6	195.5	187.7	173.8	167.6	161.8	156.4	151.3	146.6	142.2	140.1	138	136	134.1	130.3	9,386
20 inches × 22 inches.....	209.5	204.7	195.6	187.5	176	162.9	157.1	151.7	146.6	141.9	137.5	133.3	131.3	129.4	127.5	125.7	122.2	8,800
20 inches × 24 inches.....	228.5	223.3	213.3	200	192	177.7	171.4	165.5	160	154.8	150	145.4	143.3	141	139.1	137.1	133.3	9,600
20 inches × 26 inches.....	247.6	241.8	231.1	216.7	208	192.6	185.7	179.3	173.3	167.7	162.5	157.6	155.2	152.9	150.7	148.5	144.4	10,400
20 inches × 28 inches.....	266.7	260.5	248.9	233.3	224	207.4	200	193.1	186.6	180.6	175	169.7	167.2	164.7	162.3	160	155.5	11,200
21 inches × 22 inches.....	231	225.6	215.6	202.1	194	179.6	172.2	167.3	161.7	156.5	151.6	147	144.8	142.6	140.6	138.6	134.7	9,702
21 inches × 24 inches.....	252	246.1	235.2	220.5	211.7	196	189	182.5	176.4	170.7	165.4	160.4	158	155.6	153.4	151.2	147	10,584
21 inches × 26 inches.....	273	266.7	254.8	238.9	229.3	212.3	204.7	197.7	191.1	184.9	179.1	173.7	171.1	168.6	166.2	163.8	159.2	11,466
21 inches × 28 inches.....	294	287.2	274.4	257.2	247	228.6	220.5	212.9	205.8	199.2	192.9	187.1	184.3	181.6	179	176.4	171.5	12,348
22 inches × 24 inches.....	276.6	270.1	258.1	242	232.3	215.1	207.4	200.3	193.6	187.3	181.5	176	173.4	170.8	168.3	165.9	161.3	11,616
22 inches × 26 inches.....	299.6	292.6	279.6	262.2	251.7	233	224.7	216.9	209.7	202.9	196.6	190.6	187.8	185.1	182.4	179.8	174.8	12,584
22 inches × 28 inches.....	322 6	315.2	301.2	282.3	271	251	242	233.6	225.8	218.6	211.7	205.3	202.3	199.3	196.4	193.6	188.2	13,552
22 inches × 30 inches.....	345 7	337.7	322.6	302.5	290.4	268.9	259.3	250.3	242	234.2	226.9	220	216.7	213.5	210.4	207.4	201.6	14,520
23 inches × 24 inches.....	302.3	295.2	282.1	264.5	253.9	235.1	226.7	218.9	211.6	204.8	198.4	192.4	189.5	186.7	184	181.4	176.3	12,696
23 inches × 26 inches.....	327.5	319.9	305.6	286.5	275.1	254.7	245.6	237.1	229.2	221.8	214.9	208.4	205.3	202.3	199.3	196.5	191	13,754
23 inches × 28 inches.....	352.6	344.5	329.2	308.6	296.2	274.3	264.5	255.4	246.8	238.9	231.4	224.4	221.1	217.8	214.6	211.6	205.7	14,812

[We add a table of the general dimensions of Pennsylvania standard locomotives.—EDITOR.]

GENERAL DIMENSIONS OF STANDARD LOCOMOTIVES, PENNSYLVANIA R. R.

Class.	Cylinders.	Drivers.	Fire-box.	Grate area.	Total heating surface.	Tractive force per pound mean effect press. per sq. in. on piston.	WEIGHT.		
							Total light.	Working Order.	
								On Drivers.	Total.
	In.	In.	In.	Sq. In.	Sq. In.	Lbs.	Lbs.	Lbs.	Lbs.
A.....	17 × 24	4 — 68	35 × 66⅝	16.10	1,052.24	102.00	65,600	47,300	74,300
A (Anth.)	17 × 24	4 — 68	41¾ × 119⅞	34.80	1,205.00	102.00	84,100	64,000	93,500
B.....	18 × 24	4 — 62	35 × 72⅝	17.60	1,056.98	125.42	70,900	51,700	78,500
C.....	17 × 24	4 — 62	35 × 72⅝	17.60	1,056.98	111.87	66,800	50,400	75.700
C (Anth.)	17 × 24	4 — 62	34½ × 119⅞	29.13	1,161.15	111.87	68,630	55,585	79.760
D.....	18 × 22	6 — 56	35 × 59⅝	14.50	1,093.22	127.28	71,100	56,150	79,800
E.....	18 × 22	6 — 50	35 × 67¼	16.34	1,096.10	142.56	71,290	61,800	80,300
F.....	15 × 18	6 — 44	35 × 44¼	10.70	712.51	92.04	56,100	68,900	68,900
G.....	15 × 22	4 — 56	35 × 54¾	13.30	721.35	88.39	56,800	40,600	63,450
H.....	15 × 22	6 — 44	35 × 54¼	13.20	855.24	112.50	54,950	62,300	62,300
I.....	20 × 24	8 — 50	34½ × 96	23.00	1,259.56	192.00	81,650	80,500	92,700
K.....	18 × 24	4 — 78	41¾ × 119⅝	34.80	1,240.00	99.69	87,800	64,900	96,700
L.....	17 × 24	4 — 62	35 × 86½	21.38	932.20	111.87	96,000	59.750	124,100
M.....	19 × 24	6 — 50	34¼ × 62⅝	15.00	1,195.93	173.28	77,000	87,500	87,500
N.....	17 × 24	4 — 62	35 × 72⅝	17 60	1,392.00	111.87	81,700	57,700	91,300
O.....	18 × 24	4 — 62	35 × 72⅝	17.60	1,392.00	125.42	82,000	58,300	91,900
P.....	18½ × 24	4 — 68	41¾ × 119⅞	34.80	1,530.20	120.79	90,100	67,800	100,600
Q.....	15 × 22	4 — 44	34¾ × 50⅝	12.25	594.40	112.50	52,200	63,500	63,500
R.....	20 × 24	8 — 50	42 × 107	31.10	1,731.04	192.00	102.000	100,600	114,625
S.....	20 × 24	8 — 50	34⅜ × 95⅛	22.87	1,336.77	102.00		94,200	105,450

The History of a High Viaduct.

One of the routes open for the Northern Pacific down the Western slope of the Rocky Mountains was to leave the valley of the Missoula near the town of that name, climb by 2²⁄₁₀ per cent. maximum grades through a narrow, well-wooded gorge, called the Coriacan Defile, to the head-waters of Findley Creek, thence down that stream, down the Jocko and the Pend d'Orielle rivers to Clark's Fork at the mouth of the Missoula. This was the line favorably mentioned by the lamented Milnor Roberts, when chief engineer, and considerable expenditure of time, shoe leather and money in explorations demonstrated it to be the cheapest and best route, and it was adopted. It is on this portion of the railroad that the subject of this paper, Marent Gulch Viaduct, stands. Marent Gulch is the largest ravine of these foot-hills of the Rocky Mountains. A great many preliminary lines were run to see if the road could be located to avoid crossing it, but it was impossible to build around it, so a high wooden trestle was determined upon, and was located at the most eligible crossing. The surrounding mountains are covered with fine pine timber, from which the 1,064,000 ft. board measure of timber was cut which went into the original structure. Fifty-eight tons of iron came from Portland by rail to the end of the track, and was hauled by team 80 miles over bad roads to the site of the structure.

A preliminary design for a wooden structure was made by Mr. C. C. Schneider, of New York, from which the details were developed by Mr. H. J. Howe, at Missoula, under direction of Mr. I. S. P. Weeks, the Division Engineer. The original wooden bridge has been replaced by an iron one, which is described in this paper.

The original viaduct was a wooden trestle 866 ft. long and 227 ft. high, with a grade of 104 ft. per mile, making a rise of 17 ft. in the length of the bridge. This viaduct was built in 1883, at a cost of $85,600. In the latter part of 1884 an iron structure was designed by Mr. George S. Morison, and the erection of it was put under the charge of Mr. Alfred Noble, with Mr. George A. Lederle as Inspector of Shop Works. The iron structure consisted of 4-plate girders, each 30 ft. long, 5 spans of 116 ft. 8 in. deep, and girders over each of the four towers of 94 ft. 3 in., the total length of the structure being 796 ft. 8 in. The superstructure consists of 24 masonry piers, supporting 4 iron bents, and 4 iron towers, which vary in height from 17 ft. for the bents nearest the abutments to 180 ft. to the towers in the bottom of the gulch. The iron work was manufactured by the Union Bredge Co. at their Buffalo shops. The stone was supplied by Breen & Young, of St. Paul, except the granite in the abutments, which was supplied by the railroad company. The work was done entirely by hired labor, and was commenced about Sept. 1, 1884. It was rendered expensive by the cost of handling materials and by the precaution necessary to insure the safety of the existing structure.

Two of the piers rest on pile foundations, driven, probably, to bed rock. These are cut off below permanent water levels, and above them are concrete blocks 18 ft. square at the base and 12 ft. square at the top, built up in place. The concrete was made of one part Portland cement to three parts of sand, with boulders amounting to less than 30 per cent. of the whole volume. Other piers rest on concrete bases, founded on hard pan, while others rest on bed rock.

The abutments are faced with granite which was left over from Snake River bridge, and the backing is of quartzite obtained near Evaro station. The piers are built entirely of cut timestone, coping in single pieces, courses below generally in two pieces. The copings under the principal towers are single stones, each 7 ft. square by 20 in. thick, or a trifle over three cubic yards in volume, and weighing about 13,000 pounds. To handle these stones down the steep sides of the gulch was somewhat difficult, decidedly tedious and quite risky. They were slidden down on a temporary track of iron rails, and held back by wire ropes. On one occasion a coping got loose, slid down the side of the

* By S. D. Mason, Principal Assistant Engineer Northern Pacific Railroad. Abstract of a paper in the *Journal of the Association of Engineering Societies.*

gulch on the snow, which at that time covered the ground, and added to the difficulty of handling. This runaway stone struck and cut cleanly off a leg of one of the timber towers and barely missed a leg of one of the iron towers, which had just been placed in position. The shock shook the timber structure so violently that every one on it ran hastily for the land.

Two-inch anchor bolts, grouted in, extend the full height of each masonry pier, binding the courses firmly together, and each pier has four 1¼ in. dowels connecting the upper four courses. At the lower end, the anchor bolts are held by by round cast-iron disks, imbedded 2 ft. into the concrete; the tension is brought by screwing down nuts on the upper ends to a bearing on cast-iron washers resting on the masonry.

The erection of the towers was commenced in December, 1884. The spans were placed in March, 1885. The new floor system was completed in April. In erecting the towers, the tops of the posts of each section were supported by timbers thrust out from the old towers, until the braces and diagonals could be put in. This made a very cheap false work. The pieces were lowered from a derrick car having two derricks; a piece was lowered from each side of the car at the same time. The car was handled by a locomotive.

The amounts of iron and steel in the superstructure are as follows:

	Lbs.
Towers and bents	872,900
Superstructure, including floor beams and stringers	813,650
In all	1,686,550

The total cost, exclusive of traffic charges on material over the Northern Pacific Railroad, was $153,362.16

The cost in detail was:

Foundation	$21,664.59
Masonry	30,079.81
Towers	49,188.44
Superstructure	36,593.94
Floor	4,807.43
Painting	1,826.74
Engineering and incidental expenses	9,085.15
Permanent track	116.06
	$153,362.16

The traffic charges, for transportation of material over the N. Pac. R. R., at one per cent. net ton per mile.. $34,743.18

The cost of removing the wooden structure after the iron one was completed was $7,663.64.

One peculiar noteworthy feature of the iron structure is the provision for expansion and contraction of the long struts connecting the sides of the principal towers. Each "down stream" leg (as it might be called) rests upon a steel rocker—shown in the detail drawings. It resembles a short link, extending up into the foot of the post, and connected there by a 5-in. cast steel pin. The lower end of this rocker or link bears upon another 5-in. steel pin, resting in a cast-iron base bolted to the masonry.

The tower posts batter in two directions. The struts connecting the feet of posts are built of channels and lattice work. The posts of the towers are in lengths of about 27 ft. between the faced ends; they are built of plates, angles and lattice work, into rectangular form, varying in net section, from top to bottom, from 40 to 50½ sq. in.

Each panel length, in height, is strutted and sway braced both laterally and longitudinally. The strut connections are made by steel pins. The plate girders and deck spans are provided with expansion rollers at four points in the whole length of the bridge. The deck spans are pin connected.

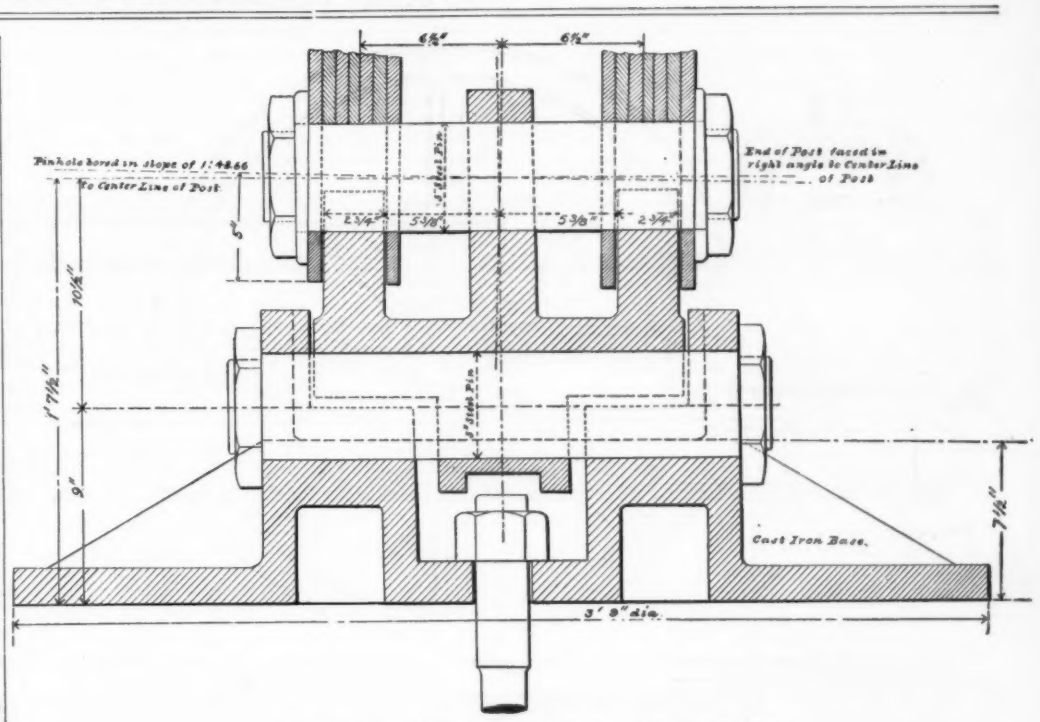
The track is laid upon 9 in. × 9 in. × 12 ft. cross-ties spaced 14 in. centre to centre. Guard rails of 4 in. × 5 in. angle iron are bolted through to every tie, and are brought together, in centre of track on the road-bed, some distance beyond each abutment. Slip joints are provided in this guard rail over each pair of expansion rollers.

The new structure was placed in position without delaying passenger trains, and but few freights, which were unavoidably held while the new floor system was being put in. A fatal accident befell C. E. Healy, foreman of erection, who fell about 175 ft. to the ground, on the third day of April, 1885. He struck one of the towers in falling, and life was extinct when his men reached the body.

During the summer months of 1885, an intelligent watchman was kept at the structure, to report its behavior under variations of temperature, and to notify the engineer-in-chief of rods needing adjustment, loose rivets, movement of spans on their rollers, action of rockers, and other phenomena incident to the new work. That his employment was agreeably diversified, may be judged from his report of Oct. 23, 1885, in which he says: "Shooting is good this fall; I have killed five deer." This helps us to appreciate the wild and solitary locality in which so much money has been expended. The work has been so well planned and so carefully erected that the watchman had but little adjustment to make. All the rods in the towers were tightened, and some of the counters in the spans. The sliding ends and the rockers worked well. No loose or missing rivets have been reported.

The wooden ribbons or guard rails on the floor were originally laid with a space of about 1 in. between the ends over the expansion rollers. It was observed the first season that the floor had begun crawling down grade, and in course of one year these guard rails butted tightly together. The entire floor system moved down hill about 2 in. A peculiar feature was noticed in movement of the track rails, one of which moved up hill and the opposite one down hill. This same movement has been observed on other steep grades of the same division, and has never been satisfactorily explained.

The track was originally laid with 56-lb. rail and plain splices; since it has been replaced with heavier rails and angle splices, the crawling movement has practically ceased. The structure appears very rigid under passing trains, the vibration of the sway rods is not noticeable and the lateral motion hardly perceptible. Special rules prohibit engineers and trainmen from applying the brakes suddenly while their trains are upon the bridge.



DETAILS OF ROCKER AT BASE OF TOWER POSTS.

The Niles Tool Works.

Among the best shops of the country the Niles Tool Works stand high for skillful arrangement and administration, and we are glad to be able to show the fine view of the interior of the main erecting shop, which is given in the supplement to this issue. It is from a very recent photograph.

The erecting shop is the centre section of the main machine room, which is 116 ft. wide in the clear by 400 ft. long. It is spanned by a 20-ton power traveling crane, built by the Morgan Engineering Co., of Alliance, Ohio. This affords facilities for handling the heaviest machinery. At each side of the erecting shop is a machine room, 40 ft. wide and 18 ft. high in the clear. One side is devoted to the erection of light tools, such as lathes, screw machines, radial drills, smaller planers, etc., and in this room are large lathes, planers and other operating tools.

The other, or north wing, is arranged in three divisions. At one end, occupying a space 40 ft. × 200 ft., are smaller planers, shapers and slotters; at the centre, 40 × 48 ft., is the tool room, which is roomy and exceedingly well appointed, and in the other end are large planers, boring mills and the engine room. In the north and south wings are twelve overhead traveling cranes, ranging from 3 to 7 tons capacity, serving all the operating tools and the side erecting floor. The largest tools, handling the heavy pieces, are located in the north wing, ranging along the erecting shop, and extending into it sufficiently for handling work on to the machines by the 20-ton crane. Among the large tools are a a planer which planes 8-ft. square by 32 ft. in length, a 72 × 72 × 24 ft. planer, a 60 × 60 × 33-ft. planer, a 60 × 60 × 20 ft. planer, a 54 × 54 × 20-ft. planer, a 48 × 48 × 18 ft. planer, an 8-ft. and a 10-ft. boring and turning mill, a horizontal boring, drilling and milling machine, with capacity to operate on work 6 ft high by 20 ft. in length, and a similar machine large enough to take work 6 ft. high by 14 ft. in length.

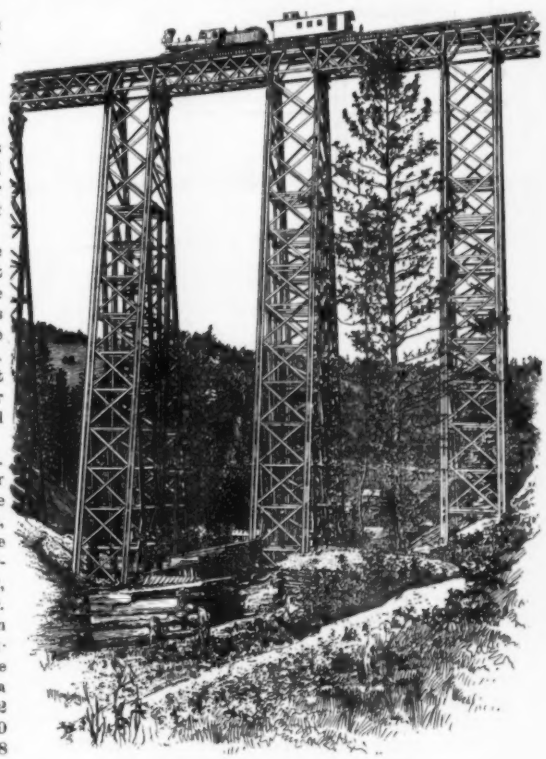
The front building of the works is 375 ft. long, 44 ft. wide and two stories high. The first floor is occupied by the offices and store-room, 130 ft. in length, and the lathe room, 245 ft. All lathes up to 30 in. swing are located in this room, conveniently arranged.

The second story contains a private office, a large and well fitted drawing room, 56 ft. long, with store room for drawings and blue printing room connected; a room 116 ft. long occupied by the gear cutters, milling and screw machines, and a room 180 ft. long, occupied as a pattern shop.

The foundry is located at the centre and consists of two wings at right angles, one 140 ft. long by 45 ft. wide covered by an overhead power traveling crane of 15 tons capacity; the other wing is 146 ft. long by 60 ft. wide, in which there are four gib cranes of 10 and 20 tons capacity, respectively, all operated by power. These wings are used for molding floors exclusively. Other rooms adjoining and connected are used for core making, cleaning castings and the cupolas. The blacksmith shop is 120 ft. long by 55 ft. wide, and is provided with cranes, steam hammers, bolt header, case hardening furnace, and every appliance to make the equipment complete.

The shops are equipped with the best machinery and appliances for producing accurate work; they are lighted by electric light and gas; in the entire works are 100 arc lights. The main machine room is heated by hot air by the Sturtevant system, and the other buildings by steam.

The tool-room is fully equipped for producing the necessary small tools for use in the works, and is well fitted with standard gauges, templets, grinding machinery and a full assortment of tools. The delivery of the tools is by an electric call system, by the use of which tools are taken to the workmen by messenger boys, avoiding the necessity of the workman leaving his work to go to the tool-room. All tools are given out on checks, and must be returned in good condition before the check is delivered back to the workman.



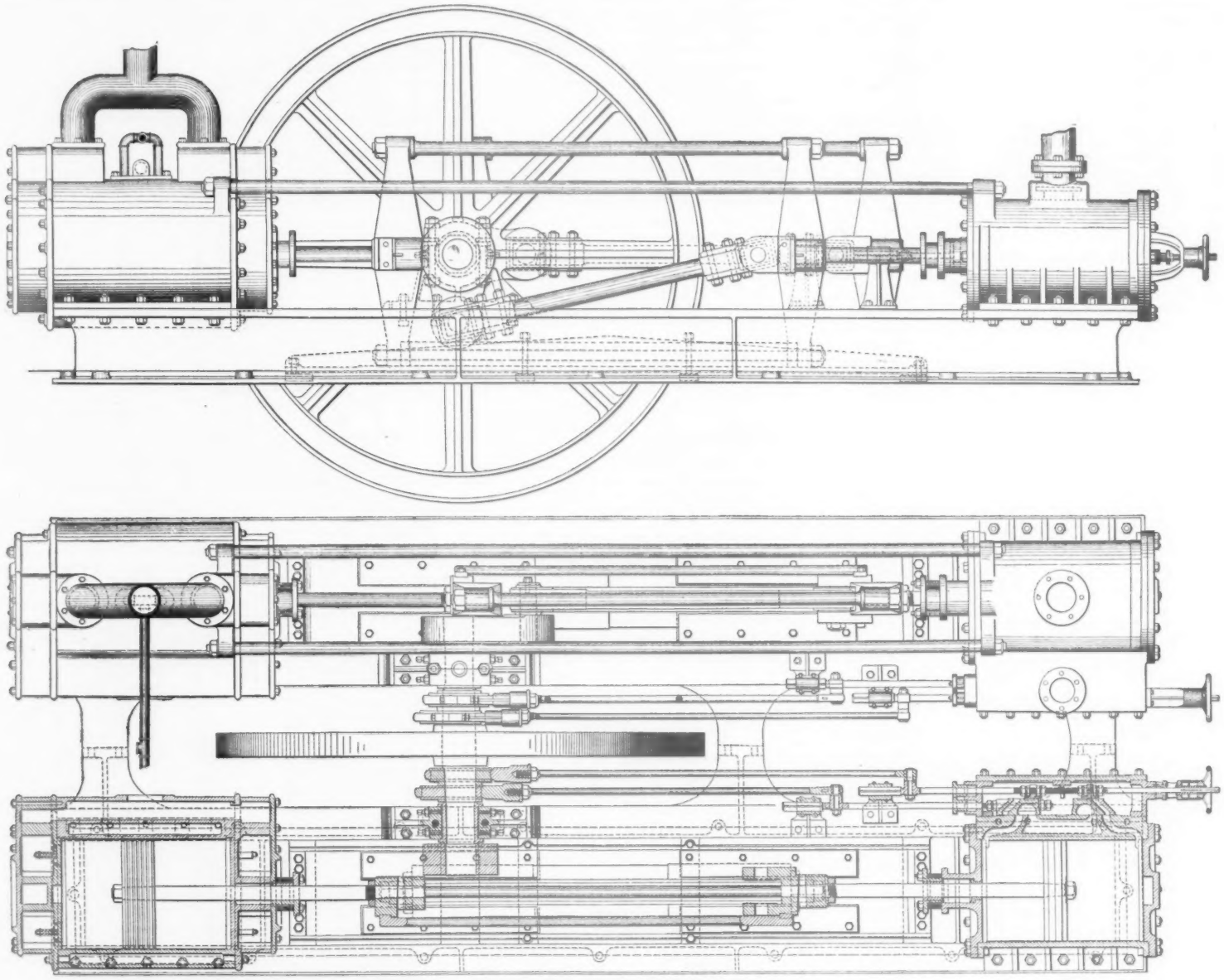
MARENT GULCH VIADUCT.

A large fire-proof building on the opposite side of the street, entirely isolated, is used for the storage of patterns. This building is 160 ft. long by 72 ft. wide, divided into three compartments by fire walls, and arranged with galleries and lighted entirely from the roof. This is one of the safest and most complete pattern storage rooms in the world.

The shops are protected by a very complete fire system, consisting of mains connected with the street mains on every side, with hydrants scattered all through the buildings and grounds. Attached to these mains also is a large fire pump, taking water from the hydraulic which runs alongside the buildings. In the pattern shop are automatic sprinklers, and the entire shops are made to conform to the requirements of the New England mutual fire insurance companies.

Two batteries of boilers, one of Babcock & Wilcox, the other of tubular boilers, furnish power for the shops. Crude oil is used for fuel under the boilers and core ovens, and is found to be exceedingly advantageous, both in point of economy, cleanliness, and maintaining a uniform pressure of steam and a uniform temperature in the core ovens. A coupled compound Corliss engine of 250 horse-power drives the entire works, except the foundry blower, which is run by independent engines. A smaller Corliss engine and a Buckeye engine are kept in reserve, in case of accident to the main driving engine.

The shops are bounded on the north, east and west by wide streets, and on the south by the hydraulic canal and



CLAYTON'S IMPROVED AIR COMPRESSOR.

Made by the CLAYTON AIR COMPRESSOR WORKS, *New York.*

another street, so that an abundance of light and air is obtained at all times, making the shops extremely light and well ventilated.

The above is a very brief outline of the general arrangement of these works, and will give some idea of their extent and appointments. The system of operating appears to be very complete and perfect. To describe it, giving details of the division of work and of the system in finishing it, the very complete and extended cost system and the system in the drawing-room, would require greater space than we can give now. We trust at some future time to be able to give a thorough detailed account of these matters.

The executive officers of the company are Alexander Gordon, Vice-President and General Manager; and R. C. McKinney, Secretary and Treasurer. Mr. Gordon has been connected with these works from their beginning, and has been the moving spirit in building the establishment up to its present proportions. He is a thoroughly practical engineer, understanding his business from the ground up. The company is doing a large business in all sections of this country, and has exported a large amount of its special machinery. Branch offices and warerooms are located in New York, 96 Liberty street; Philadelphia, 705 Arch street; and Chicago, Phenix Building, Jackson street.

The Clayton Air Compressor.

In our illustration is shown the latest form of the well-known Clayton compressor. In this improved form the maker has aimed to produce an air compressor which will furnish a given amount of air under high or low pressure, at a minimum first cost, maximum efficiency and great accessibility in case of repairs. Some of the improvements are:

First. The patent connecting rod arrangement which is a combination of the slipper guide, vertical cross-heads and connecting rod, which admits of placing the connecting rod between the steam and air cylinders, the tops of which are tied together with heavy brace rods, which prevent the bed plate buckling with the strain of the compression, which comes in a direct line with the bed plate and the brace rods at the same time. By this arrangement a much stronger machine can be built with less gross weight and with a saving of considerable floor space over the compressors having the fly-wheel, or wheels, on the end of the machine. The fly-wheels are placed in the centre of this compressor, thus obviating any danger of personal injury through coming in contact with them, and there is no necessity for removing them to get at any part of the steam or air cylinders. The shaft and air cylinders are not exposed to the heat of the steam cylinders.

Second. The patent safety suction valves, the seats of which are firmly screwed into the heads and the valves secured by two nuts, safety stems and a spring cotter from ever becoming loose and getting inside the cylinders. The "cages" for preventing the valves falling into the cylinder are dispensed with, the safety stems being more satisfactory, and, therefore, the piston travels the full length of the cylinder, there being no lost space at each end of the stroke. The valve faces are protected by a slight elastic composition disk which prevents any hammering and consequent leakage. These disks can at any time be renewed at slight expense, and the valves and seats on the larger air compressors can at any time be removed or inserted from the outside by means of the tools furnished with compressor.

Third. The patent water jackets.

Fourth. The patent combined speed and pressure governor.

In addition to the foregoing there are other features of excellence embraced in these air compressors which show the superiority of their general design. The superior proportions of these machines and the character of the workmanship are attested by the fact that they have been used in sinking many of the caissons for the great railroad bridges built during the past ten years.

Besides their use in sinking caissons, furnishing air to divers in submarine operations, working rock drills, coal cutters and underground hoisting and pumping machinery, they have been very successful in the compression and transmission of natural gas. Four of a large size are being used for this purpose at Rixford, Pa., forcing the gas a distance of thirteen miles for heating and lighting in the city of Bradford. They are also in use for a like purpose at Wellsville, N. Y.

Two duplex gas compressors are now under construction for compressing 2,000,000 cu. ft. of gas per day to a pressure of 200 lbs. per sq. in., for supplying the city of Louisville, Ky.

The Cyclone Snow Plow.

The Vulcan Iron Works and Messrs. Wells, French & Co., of Chicago, have been for some time past engaged in constructing a ponderous steam plow known as the "Cyclone." This machine is now completed and stands in the Wells, French & Co.'s yard ready for shipment. It will be sent to the conventions at Niagara Falls and Saratoga, and will there be exhibited under steam.

This snow plow is double acting—that is, it bores into the snow bank and throws the snow to one side by two distinct mechanisms. In front there is a large expanding spiral, like the end of a gimlet magnified, which bores into the snow bank in advance of the fan or discharging wheel, to which it delivers snow, which is then ejected to either side of the track as may be desired; a large damper in the discharging pipe controlling the direction of the stream of snow. The spiral auger is driven by a pair of marine engines mounted at right angles on the same shaft and revolving always in the same direction. The discharging fan is driven by two pairs of marine engines, which drive pinions which gear into the same spur gear on the shaft of the discharging fan. This shaft is hollow, and through it passes the shaft of the spiral auger. The steam for driving these engines is furnished by a large locomotive boiler, built by the Baldwin Locomotive Works. The engines and boiler occupy the entire length of a box car, 48 ft. in length, built especially for the purpose. The sills of this car are constructed of 12-in. I beams braced laterally with plates. The transoms are wrought iron girders filled in with cast iron blocking. The cars are supported by four large truss rods about 2¼ in. in diameter, which pass underneath body bolsters made of 12 in. I beams, placed under the longitudinal sills. The trucks are four-wheeled, with swing bolsters. The axles are 5½ in. in diameter and 8 in. long. The boiler is 54 in. in diameter and 27 ft. long, and contains 185 tubes 2¼ in. in diameter and 14 ft. long. The grate is 12 ft. long by 3 ft. 6 in. wide. The boiler has 1,500 sq. ft. of heating surface and is designed to carry a pressure of 150 lbs. The fireman stands on the foot plate of a locomotive tender which accompanies the plow. This tender is the ordinary eight-wheel type, carrying about 3,000 gallons of water, and was furnished by the Chicago, St. Paul & Kansas City. A steam gauge is placed on the back head of the boiler, where it can be readily observed by the fireman.

The car body is 48 ft. long, and the height from the rail to the highest point is 14 ft. and 9 in.

Three steam pipes lead from the boiler to the engines, one to each engine. The throttle valves are controlled by the engineer, who is at the front of the plow, long rods passing from levers at that point to the throttle valves, which

located at the steam dome of the boiler; thus the whole operation of the plow is under direct control of the engineer. The engines are reversed by means of a screw reversing gear. The exhaust from the engines is carried to the smoke-box of the boiler, where they enter exhaust pipes as usual. The boiler is supplied with water by Sellers injectors through checks as usual. A blower for blowing the fires is placed in easy reach for the fireman. There is an outer bearing for the spiral auger outside of the discharging fan. This bearing being continually buried in the snow, it is a difficult problem to keep it oiled. Special attention has therefore been paid to its construction, and means devised for conveying oil through a pipe which is inclosed within a live steam pipe fed directly from the boiler. The steam also enters within the outer shell of the bearing, and keeps it continually warmed. The condensation from the steam is drained out of the bottom of the bearing. By use of this invention, which has been patented, the bearing is always warm, and is fed with heated oil. The bearing for the discharging fan is also warmed by steam. Every attention has been paid to the details of the construction of this plow, and the parts are well put together and admirably finished.

The pinion and spur gears which drive the discharging fan are made of alluminum bronze mounted on cast steel centres in such a manner that the gear ring can be readily replaced. A head-light is placed on top of the casing surrounding the discharging fan, just in front of the discharge nozzles. The square casing which cuts the sides of the snow bank is raised 3 in. from the rail at the bottom.

One of the particular advantages claimed for this plow is that the entire operation of all the mechanism is under direct control of the engineer at the front of the plow. If the fan is unable to clear itself of the large amount of snow being supplied by the auger, the speed of the auger can be slackened or the discharging fan accelerated and the difficulty at once removed.

The inventor of this snow plow is Mr. E. P. Caldwell, of Minneapolis, Minn.

The Ionia Steam Inspection Car.

The accompanying illustrations show a new and handy steam inspection car. Fig. 1 is a side elevation of the car ready for service. Fig. 2 is a section through the boiler, the construction of which is quite interesting for two reasons: first, because it has a great steam generating power in proportion to its weight; second, on account of the rapidity with which steam can be raised. The wheels, axles and car body, as shown in fig. 1, are not materially different from the ordinary section car, except that each axle is provided with spiral springs above the axle boxes which slide in jaws in a manner similar to the boxes in passenger car trucks. These springs and sliding boxes is to relieve the jar of the machinery and render the car more comfortable to ride upon. The weight of the car when fully equipped for service, with water tank full of water and a full supply of coal is about 700 lbs. The weight with all the steam attachments is less than twice that of the ordinary section car.

The following is a description of the machinery: A small upright boiler shown in detail in fig. 2, is mounted just in front of the rear axle. This boiler is furnished with a smoke-stack, water glass, whistle *D*, steam gauge, blow-off *F*, and check valve *G*, with intermediate check *H*, through which the boiler is fed. A hand pump is placed at *I*, which takes water from the tank under the passenger seat when desired. The steam cylinder *L*, is placed in the centre of the car on the front of the boiler. The throttle valve is attached to the boiler at *M*. The guide and connecting rod are vertical and are shown at *N*. The shaft *O*, carries the eccentric, and upon it is mounted a sprocket wheel, as shown, around which passes a link belt, shown at *P*, which also passes over idlers at *Q Q*, and around a large sproket wheel on the forward axle which is used as a driving axle. The idlers take up all slack in the belt. The use of the link belt gives the car greater flexibility than could be had with any other means of transmitting the power. The brakes are applied by means of the lever *S*, which is placed within easy reach of the engineer, who sits in the seat placed on the near and left hand side of the car as shown. The coal supply is carried in the coal tank *U*, which holds about one bushel, or sufficient to run the car a distance of 50 miles. The swinging bucket *V*, is used for taking water to fill the tank when desired. The seat over the front axle will carry three persons comfortably.

The boiler shown in fig. 2 consists of an outer casing 12 in. in diameter, and an inner casing, leaving a water space between. The grate is placed at *A*, the ashes are drawn out at *B*, which is the ash pit door. The fire is fed through the fire door *C*. The upper and lower tube sheets are apparent in the engraving, the upper one being shown at *E*. The tubes are six in number, 2 in. in diameter and 9 in. long. A steam dome *F*, to which are connected the boiler attachments and throttle valve is placed in the smoke arch *G*. This steam dome is made of a boiler tube with ends brazed in. It is connected in the boiler by one in. pipe shown at *H*. In order to increase the circulation and the rapidity of steam production, a coil of ⅝-in. copper pipe is placed in the fire box. The lower end of this coil is connected to the water space just above the fire, and the upper end to the centre of the lower tube sheet, as shown. The foundation of the boiler consists of a one-eight iron plate, 15 in. in diameter. The boiler is made of a seamless tube 12 in. in diameter, ¼ in. thick and 2 ft. 6 in. long. The fire box is made of $\frac{3}{16}$ in. steel with one joint, as shown. The tube sheets are of ¼ in. steel. The boiler is boiler machinery in the ordinary form. This great weight prevents the car from being handled by one man, when it becomes necessary, to leave the track at intermediate points. This car can be easily handled at highway crossings by one man, and can be removed from or placed on the track at any intermediate point by two men.

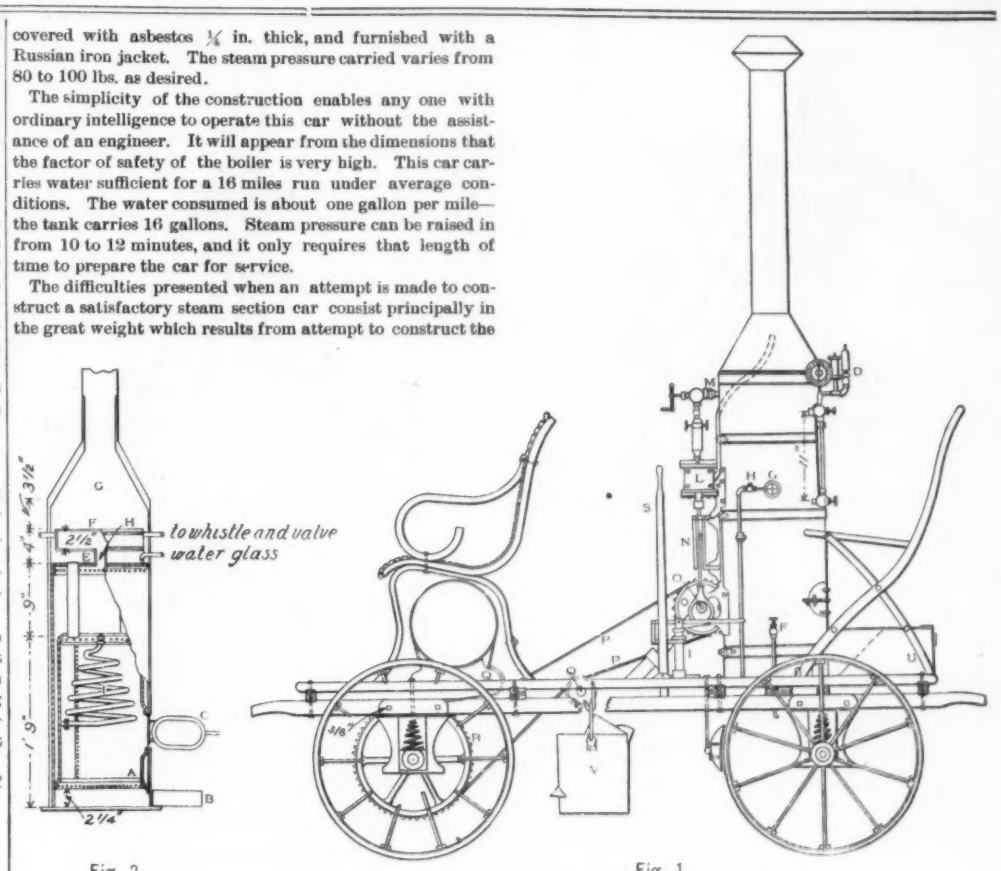


Fig. 2. Fig. 1.

THE IONIA STEAM INSPECTION CAR.

This car was designed by Mr. John Doyle, Chief Road Master, and Mr. Timothy Morrissy, of the mechanical department of the Detroit, Lansing & Northern, to meet the requirements of engineers, division superintendents, road masters, bridge superintendents, lumber agents, and wood and tie inspectors, who are compelled to have a close and accurate knowledge of the condition of the permanent way. Such a knowledge is not obtainable by inspection from the rear of a train, or from the heavier class of inspection cars, which are compelled to run on schedule time and therefore unable to stop and make close inspection when desired. In order to increase the safety of this car it is furnished with a powerful lever brake with which a stop can be made within 25 or 30 ft. and the car immediately removed from the track.

The success of this car has been assured by trials in actual service on the Detroit, Lansing & Northern, the Grand Rapids & Detroit and the Saginaw & St. Louis roads during the last year. A test was given for the benefit of observers last week, on a grade of 97 ft. to the mile. The small engine propelled the car up this grade at about 11 miles per hour; on a level track, it can easily make 20 miles per hour. The car is made by the Ionia Steam Hand Car Co., Ionia, Mich.

Safety for Railroad Employes.

WASHINGTON, April 22, 1889.

TO THE EDITOR OF THE RAILROAD GAZETTE:

A calculation based upon accident returns in the reports of State Commissions* indicates that every year some 2,700 able-bodied men are killed, and over 20,000 injured in the discharge of their duties as employés of the railroads of this country. A similar calculation for passengers shows about one-tenth as many casualties. Last year, according to statistics in the possession of the Life Saving Bureau, the total number of passengers and seamen lost from the shipping of the United States on lakes, rivers and the sea, was 862. The sea does not destroy quarter as many Americans as the railroad car. It is infinitely more merciful in that it only kills, and does not maim and mutilate.

There are two things which, in view of these facts, seem surprising. One is that while not one-tenth as many passengers are killed and injured as employés, we hear much public outcry about casualties to the former and almost none about those to the latter. The second is that no effort in any degree adequate is making to abate this destruction and mutilation. The first is not hard to explain. When a passenger train goes through a trestle and its inmates are burned up, every citizen shudders because he feels that their fate might have been his. Every man expects to be a passenger, but not one in a thousand expects to be a freight brakeman. Coupling freight cars and braking freight trains belong only to a single class, and the accidents, however numerous and dreadful, which occur in those occupations do not trouble the public unless attention is very pointedly directed toward them.

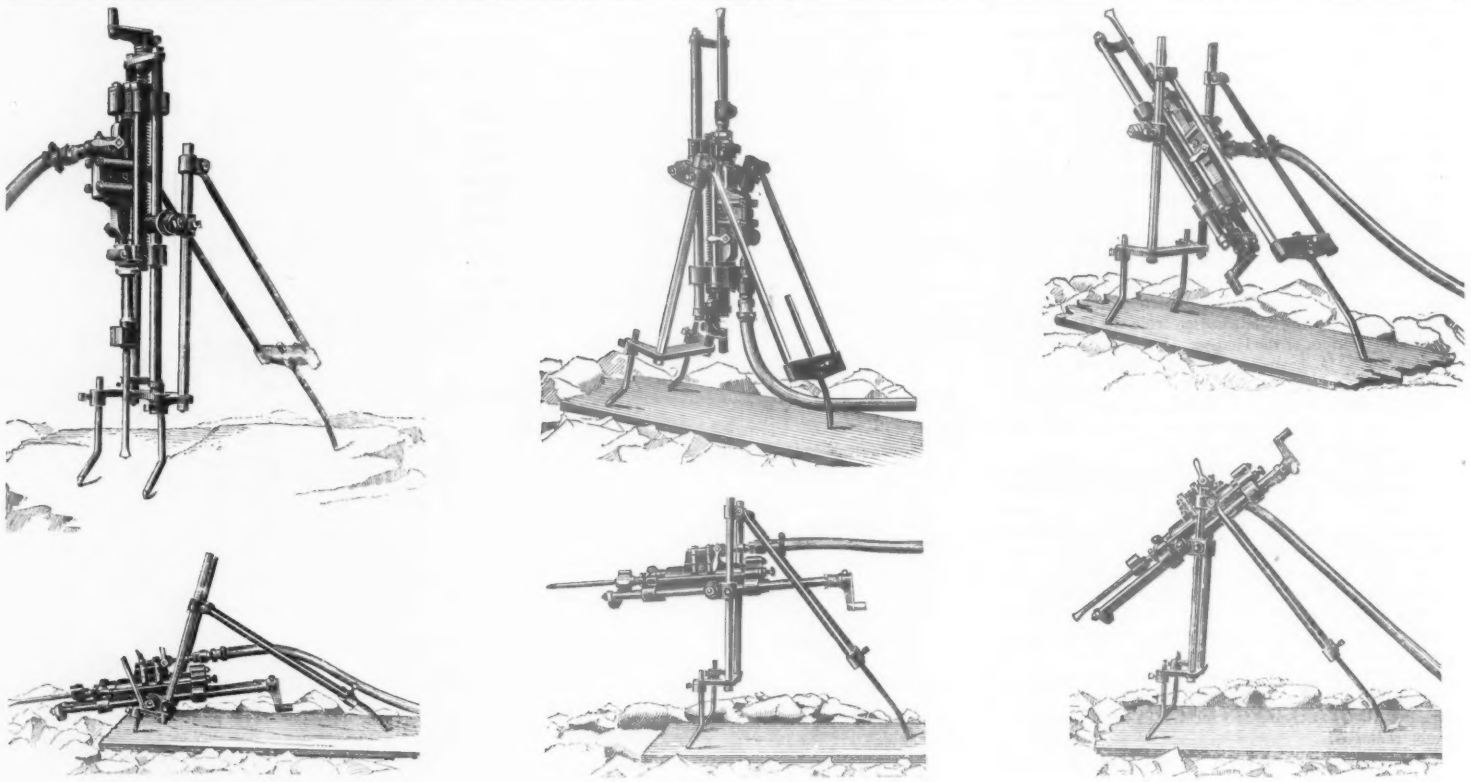
The explanation of the second fact is by no means so obvious. It does not appear that there is no remedy. Three-fifths of these casualties to employés are immediately incident to two features of their work: first, that they have to go between freight cars to couple and uncouple; and second, that they have to traverse the tops of moving trains. If, then, devices can be employed which will make it unnecessary for men to go between and on top of cars, we may fairly expect that, by their use, sixteen hundred lives may be yearly saved, and over twelve thousand lesser accidents prevented. Are there any such devices existing in a practicable form? Have automatic couplers and train brakes been developed to such a reasonable degree of efficiency and economy that there is no obstacle to their use which can be fairly set over against this enormous saving of life? There may be a few who, as regards couplers, would answer "no" to this question, but surely they are only a few, and probably even they would admit that if the coupler question is not solved now it is in no way to be solved at all. The failure in a remedy is not due to a mechanical deficiency in life-saving appliances.

Wherever the lives of citizens are put constantly in peril we are accustomed to see the police power of the state exerting itself to the utmost to provide against that peril. The United States regulates transportation by sea in the most minute manner and with a view to the greater safety of passengers and seamen. A complicated and expensive machinery of Inspector General, Supervising Inspectors, Inspectors and Assistant Inspectors is looked to to enforce every precaution against loss of life. The statutory regulations cover the whole field from the testing of boilers to the serving of lime juice to seamen. Its activity in securing safety for transportation by sea gives cause for surprise that the Federal Government has done nothing to secure safety for transportation by land.

The action of states, though necessarily inadequate, shows indeed, no reluctance in regulating mechanical appliances on railroads. The multitude of statutes in regard to switching, flagging, bridges, speed of trains, etc., a multitude greatest in states which, like Massachusetts, have been most successful in railroad regulations, force us to believe that if the states have done little to check the waste of life where it is greatest it is because of lack of power rather than lack of will.

So small has been the development of protection to railroad hands by the police power that a tone is sometimes taken which seems to imply that it is a kind of impertinence for the state to step in between a railroad and its employés and prescribe safety appliances. Proposals of such regulations seem sometimes to be taken as a reflection upon the humanity of railroad officers. On the contrary, I think it clear that, assuming those who control railroads to be neither more nor less humane than other classes of citizens, there is no reason whatever to expect that they will take adequate action to protect their employés; that they have not taken such action in the past, do not take it now and are not likely to take it in the future. A railroad is not a benevolent organization and is very ill adapted for benevolent action. Those officials who are brought face to face with the suffering of trainmen are not the ones who have power to appropriate money to prevent it. If we follow back the line of authority to those who

*The commissions of Alabama, Connecticut, Iowa, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, New York, Ohio, Pennsylvania, Virginia.



THE ACROBAT.

Made by the RAND DRILL CO., *New York.*

hold the purse we find the sense of responsibility for death and injury to trainmen at a minimum. Expensive changes are and will be made only as they are expected to be profitable. It is only occasionally and incidentally that life saving is profitable. Even the expectation of profit in such matters acts very tardily. Outlays which produce a distant and indirect return are always more difficult to justify to directors than those whose advantages are near and obvious. Money invested in safety appliances comes under the former description. I think it would be very difficult to point out a case in which a railroad has gone to much trouble and expense from humanity alone, unsupported by motives of economy or by outside pressure. How much outside pressure has to do with the question may be suspected from the fact that while not one-tenth as many passengers suffer from railroad accidents as employés, at least ten times more care is taken to protect the former than the latter. The roads have no sufficient motive to protect trainmen, and consequently they do not protect them. Let us see if there is any good reason to expect that they will in the future.

It is to be noted that the practical question as we are compelled to consider it here is not whether employés will gain protection because it is their right as citizens, but whether they will gain it incidentally to action which has an entirely different purpose. Train brakes and automatic couplers may possibly be adopted because they save time and repairs, prevent collisions, make greater speed possible, or for other economical reasons, but there is no ground for supposing that they will be adopted because they save lives and limbs. The measure of probability must be great which will justify entrusting the protection of a considerable class to the incidental action of forces which do not aim directly at it.

In April, 1888, when the contour lines for the Master Car-Builders' coupler were published, the expectation of those who had pushed the movement apparently was that the standard coupler would be generally and immediately adopted. In the last number of the *Gazette* for the year it is noted as a cause for satisfaction that a single system controlling 2,500 miles had just ordered the coupler on all new equipment. Is that a satisfactory fulfillment? Is there, in fact, any general movement to take up the M. C. B. coupler? Is there not, more nearly, general indifference and, in many quarters, deliberate opposition? Considerable progress has no doubt been made towards the use of train brakes on freight trains, but it is still confined to a comparatively few enterprising systems so situated that they can use such brakes to the best advantage. There is, to my mind, no indication that brakemen will, in the near future, be relieved from the necessity of their perilous journeys over moving trains. From the point of view of humanity and public safety, the attitude of the roads in both these matters is apathetic.

The case is one where the duty of the state to afford protection is obvious and pressing, but where the agencies employed have been unsuited to the purpose. Legislation by individual states is and must be wholly inadequate to enforce the use of safety appliances on railroads. There must be uniformity and the action of legislatures can never be uniform. The railroads of this country form, in reality, one great system. The constant movement toward homogeneity is seen not more in traffic associations and uniform classifications than it is in unity of track gauge, interchange of cars and the continual consultations of Master Car-Builders to settle upon standard wheels, pedestals, axles, dead-blocks and draw bars. In all that concerns rolling stock, railroads are even less amenable to local police control than shipping. If we are to regulate to any purpose the mechanical construction of vehicles of railroad transportation we must do it as we regulate the vehicles of water transportation, by Federal power.

No insuperable or even alarming obstacle exists to the exercise of such power. The reforms most needed are the simplest. No expensive technical investigation is necessary, probably none is advisable. Such investigations can always be carried on better by the railroads themselves than by any supervising authority, and fortunately they have, in these cases, been so carried on, and results reached that are definite and the best that can be hoped for. The problem how to bring about, in the interests of safety, the general use of train brakes and of uniform automatic couplers is a technical problem only in a very narrow sense; in the sense that technical considerations cannot be neglected. In a wider and truer sense it is a problem of public policy with which, *prima facie*, we should expect public agencies to deal. The question is one of legislation and of such administration as may be necessary to enforce it. As a legislative problem it offers no exceptional difficulties. The subject matter is of the simplest compared with many of the questions with which Congress deals. It is simpler, for instance, than the question of regulating shipping, which regulation is successfully accomplished, and it calls for no such complicated administrative machinery.

CHARLES H. COOLEY.

The Acrobat.

The mounting for a machine drill, which is shown in the illustrations, is made by the Rand Drill Co. for mounting what that company calls its "kid" drill. This drill, which weighs about 100 lbs., is made for block holing—that is, for breaking up large pieces of rock thrown down in blasting. It has a cylinder 1⅞ in. diameter and 3⅝ in. stroke, the length of feed is 10 in., and it is recommended for drilling holes up to 1½ ft. deep.

The "acrobat" was devised for drilling horizontally in blocks, or for drilling holes looking upward from the feet of the drill. It is to be noticed that with this device the machine is well braced in drilling horizontal holes, by the back leg taking hold of the standards above the drill. The drill itself can be raised or lowered on the standards so as to start a block-hole under a detached piece of rock with ease. The whole apparatus is small, and is commonly used for block-holing by placing it on a piece of plank about 2 ft. square, thrown on the sprawls surrounding the block. The weight of a man's foot is generally sufficient to keep it in place.

Jonson's Compound Stationary Engine.

This is a new type of engine, recently put upon the market by the Jonson Foundry & Machine Co., 118th street and Harlem River, N. Y. As shown by the cuts, there are two steam cylinders, placed side by side, the connecting-rods working in trunks, and the cranks being set at an angle of 180 deg., with each other. All the working parts are inclosed as shown.

It will be seen that the arrangement forms a pair of half-trunk engines, the high-pressure cylinder being the annular space between the trunk and the steam-cylinder, and the low-pressure cylinder having the full area of the piston above the trunk. In the engine here illustrated the diameter of the steam cylinder is 12½ in., and the diameter of the trunk is 8⅝ in., the stroke being 10 in., so that the engine has two high-pressure cylinders, each about 8 in. in diameter. In the operation of the engine, steam is admitted to the high-pressure cylinder for the upward stroke of the piston, and being exhausted into the low-pressure cylinder actuates the piston on the return stroke. For small engines, the valves of the high and low-pressure cylinder form one casting, and the steam from the high-pressure cylinder is exhausted through ports in the valve to the low-pressure cylinder. When an automatic cut-off or link-motion is fitted, an independent steam valve for the high-pressure cylinder, shown at *a*, is added so as to avoid damaging the action of the low-pressure valve and the high-pressure exhaust.

As an example of this practice, the manufacturers state that in an engine of 275 horse-power, now being constructed for a U. S. tender, a piston valve is to be used for the steam valve of the high-pressure cylinder, and a slide-valve for admitting the steam into the low-pressure cylinder and exhausting it therefrom. For small engines an ordinary governor, not shown in the cuts, is usually attached.

The special advantages claimed for this engine are compactness, a low centre of gravity, and particularly the fact that all the moving parts are in pairs, equal and acting in opposite directions, thus securing a perfect mechanical balance, and adapting the engine to high rates of speed. The claim seems to be well founded, and it is probable that this engine can be run without sensible vibration, and may thus be found serviceable for the electric lighting of trains. No particulars of the economical performance of these engines were furnished; but it is reasonable to suppose that the steam consumption will not be excessive.

TECHNICAL.

Locomotive Building.

The New York, New Haven & Hartford has contracted with the Rhode Island Locomotive Works for 10 standard eight-wheel engines, to be used for either passenger or freight service. They will be duplicates of engines already on that road with the exception of the boiler, which is made to carry 180 lbs. pressure per square inch. These engines have 18 × 24 in. cylinders, a wagon-top boiler 53¼ in. diameter, of ⅝-in. steel; driving wheels, 64¼ in. diameter; grate, 64⅛ × 33⅝ in.; 193 tubes, 2 in. outside diameter, 11 ft. 1 in. long; driving-wheel journals, 7 × 8 in.; truck wheel journals, 4¾ × 8 in. Their total weight is 88,000 lbs.; weight on drivers, 54,000 lbs.; on truck, 34,000 lbs. The tender is carried on eight wheels, and has a wooden frame. Its tank is of 3,200 gallons capacity. The engine truck has four 30-in. Paige spoke steel-tire wheels. For the Providence & Springfield road the works have recently turned out a handsome eight-wheel locomotive, with cylinders 16 × 24 in. Total weight, 79,340 lbs.

Car Notes.

The St. Charles Car Co., of St. Charles, Mo., has received orders from the Union Pacific for 12 passenger, four baggage and four mail cars and 15 cabooses. The company has also recently finished and delivered 17 chair cars for the same road. The Missouri Pacific has just placed an order with the company for building 500 box cars.

The Rome, Watertown & Ogdensburg is asking for bids on 200 box and 100 coal cars.

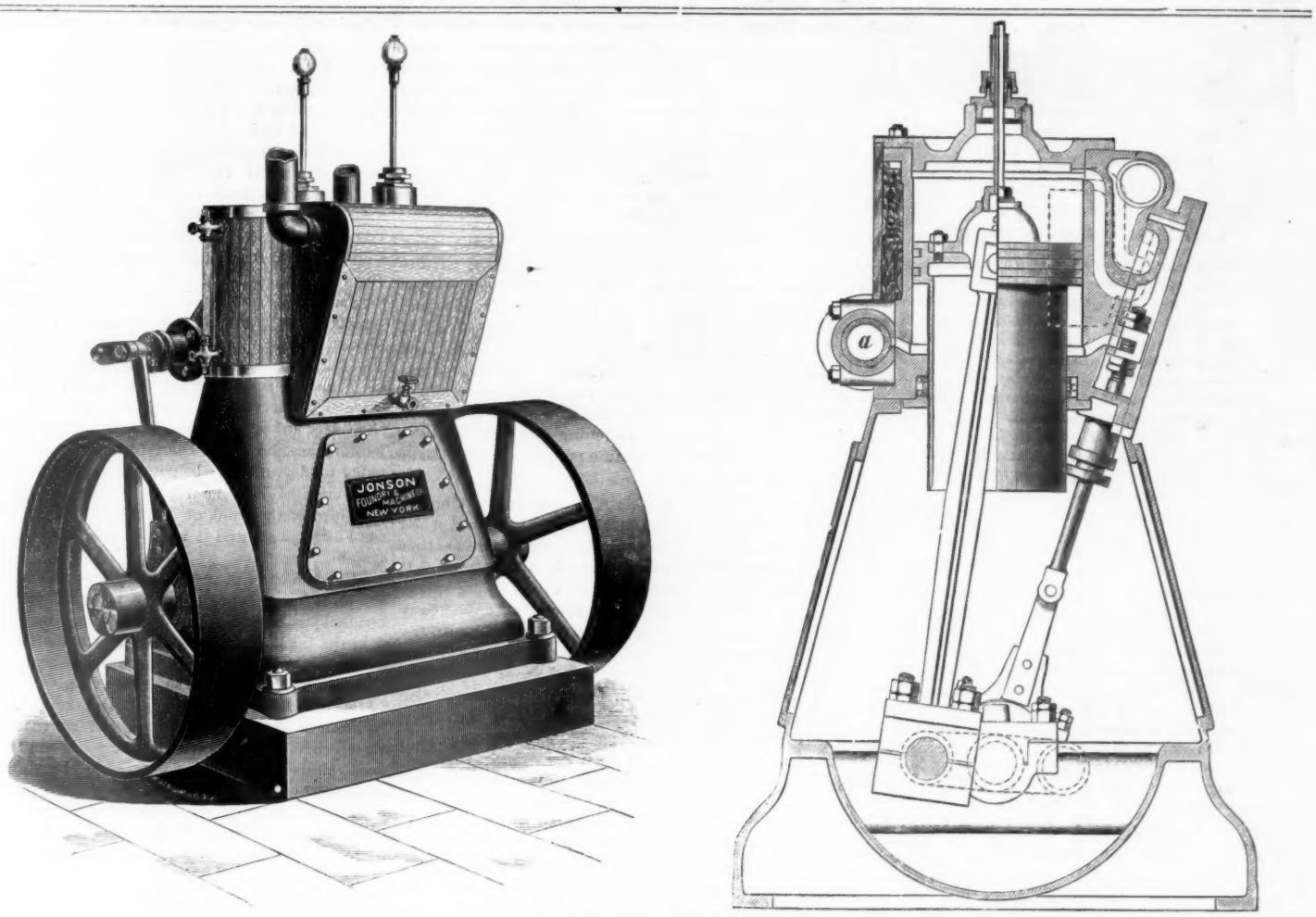
The New York, Lake Erie & Western is negotiating for the building of 200 box cars.

The Texas & Pacific will in a few days place orders for building 500 box cars.

At the United States Rolling Stock Co.'s Anniston shops there has just been completed a number of new cars for the Florida Railway & Navigation Co.

The Maine Central is completing at its shops at Waterville a lot of 100 freight cars, mostly box.

The Ohio Falls Car Co., of Jeffersonville, Ind., has within the past few weeks received orders for 20 platform cars for the Midville, Swainsboro & Red Bluff road, and smaller orders for the Georgia Southern & Florida, the Tucson, Globe & Northern, and the Wrightsville & Tennille roads, as well as for 40 coke cars for the Tennessee Coal, Iron & Railroad Co.



JONSON'S COMPOUND ENGINE.

Of the recent order for 500 coal cars which the Valley road of Ohio placed with the Erie Car Works recently, over 125 have been delivered, and the order is being completed at the rate of over 12 a day.

The St. Charles Car Co. delivered this week two parlor cars to the Toledo, Ann Arbor & North Michigan. They were on exhibition in St. Louis for a few days. They are equipped with the latest Johnson reclining chair, and have a smoking-room and a ladies' sitting room. They are most elegantly finished in mahogony and quartered oak and embody the best features in modern car building practice.

Bridge Notes.

The contract for building the iron draw-bridge over the Ocmulgee River, near Abbeville, for the Savannah, Americus & Montgomery, has been let to the Penn Bridge Co., of Beaver Falls, Pa. Trains are to be passed over the false work by June 20, and the bridge to be finished by Oct. 1, next.

The Phœnix Bridge Co., of Phœnixville, Pa., is to erect for the Central of New Jersey a new iron bridge over the Lehigh River, near Easton, Pa.

The Milwaukee Bridge & Iron Co., of Milwaukee, Wis., is constructing the iron bridge at Bay City, Mich. The bridge will cost about $130,000 and will be 820 ft. long exclusive of approaches. The Milwaukee Bridge & Iron Co. also has the contract for a 300-ft. span bridge over Maumee River at Fort Wayne, Ind., at a cost of $26,500.

The Vermont Construction Co., of St. Albans, Vt., has the contract for erecting an iron bridge at Alstead, N. H.

The Toledo Bridge Co., of Toledo, O., will soon commence work on the iron bridge over Flint River, at Montezuma, Ga.

The City Engineer of Council Bluffs, Iowa, will receive bids until May 6 for building three iron bridges in the city. The bridges will be 50 ft. span each. The substructure will be iron tubular piers about 12 ft. long and 9 in. in diameter.

The Philadelphia & Erie is replacing a number of wooden bridges and trestles along its line with iron structures.

Manufacturing and Business.

The B. Roth Machine Co., of St. Louis, Mo., is introducing an electric headlight, invented by a Mr. Atwood, and which is now being tried on the Missouri Pacific. This headlight has an ordinary reflector, and the lamp is not essentially different from the ordinary arc light, except that the carbons are fed by a new method for automatic feeding. The current for the light is obtained from a small dynamo placed on the front buffer deck plate. This dynamo is driven by a small 1 h. p. rotary engine placed beside it. This firm is prepared, also, to equip whole trains with electric lighting fixtures, the power to be taken from the small engine on the front of the locomotive or from an independent one in the baggage car.

The Dover & Statesboro Railroad is negotiating for rolling stock and for 35 and 40 lb. steel rails. F. T. Lockhart, of Augusta, Ga., is President.

The Lidgerwood Manufacturing Co., of New York, report an increasing demand for its improved hoisting machinery in the South. The company has recently appointed Messrs. Miller & Kettig its Birmingham, Ala., representatives.

Murphy & Co., varnish makers, announce that they will remove their New York office to the Newark Works May 1 next. The plant at Newark has recently been greatly enlarged.

The Murphy Car Door Co., with a capital of $50,000, has been organized at East St. Louis, by P. H. Murphy, W. S. Wilson and others, to manufacture a freight car door fastener.

Booth & Flynn, of Pittsburgh, have the contract for grading the incline at Pittsburgh for the Pittsburgh & Castle Shannon Railroad, and Shultz & Son will build the trestle work, and Robinson, Rea & Co. will build the boilers. It is thought that the incline when complete will cost about $92,000.

Iron and Steel.

The Leechburg Foundry & Machine Co., of Pittsburgh, has recently filled large orders for rolls from Phillips, Nimick & Co., of Pittsburgh, the Reading Nut & Bolt Co., of Reading, Pa., and from the Pennsylvania Steel Co., of Harrisburg, Pa., besides numerous small orders from various sections of the country. The Chester Rolling Mills, at Thurlow, Pa., will supply the company with ingot molds for its new steel plant, and the Troy Steel & Iron Co., of Troy, N. Y., will furnish the ingot molds for the Bessemer steel plant.

The employés of the new Bessemer Steel Co. works at Duquesne, Pa., about 1,000 in number, quit work April 20, and demanded an advance in wages to the scale paid at the Braddock mill.

The Swindell & Smythe Co., of Pittsburgh, have in course of completion the following plants: For the Columbia Iron & Steel Co., Uniontown, Pa., a 10-ton open hearth steel melting furnace, and for the Montreal Rolling Mill Co additional gas producing plant, mill heating furnaces, and for the Ramel-Conley Iron & Steel Co., Brewsters, N. Y., a complete steel plant of open hearth steel furnaces, cranes, cars, etc. The firm has recently filled important orders for the following firms: The Lobdell Car Co., of Wilmington, Del.; the McConley & Torley Co., of Pittsburgh; the Kansas City Bolt & Nut Co.; Riverside Iron Works, Wheeling, W. Va.; the Kelly & Jones Co., Greensburg, Pa.; B. Atha & Co., Newark, N. J.; the Addyston Pipe & Steel Co., Cincinnati, O.; J. Illingworth & Co., Newark, N. J.; Johnson Foundry Co., Johnstown, Pa.

The firm of McGill, Manchester & Co., general machinery manufacturers, at Pittsburgh, has been dissolved, and the firm has been reorganized under the firm name of McGill & Co.

The Pennsylvania Tube Works, of Pittsburgh, have received an order from the Standard Oil Co. for 100 miles of 8-inch pipe.

The Otis Iron & Steel Co., of Cleveland, O., is erecting a forge 30 × 60 ft., which will contain eight hammers.

The Shiffler Bridge Works, of Pittsburgh, Pa., has recently completed for the Jefferson Iron Works, Steubenville, O., an extension to its cast house, and has now building an extension to the cast house of Shoenberger, Speer & Co., of Pittsburgh.

Mackintosh, Hemphill & Co., of the Fort Pitt Foundry, at Pittsburgh, have already commenced to rebuild that portion of their works which was recently destroyed by fire.

A steam-hammer housing weighing 40 tons was successfully cast in the Morgan Engineering Co.'s foundry, at Alliance, O., recently. A duplicate will be cast in a few days. It is believed they are the heaviest ever cast in this country.

The Rail Market.

Steel Rails.—A sale of 5,000 tons for Savannah delivery has been made by an eastern mill at a price under $27 at mill. The Louisville & Nashville has given an order, at private terms, to a Pittsburgh mill for 15,000 tons, delivery to extend till May, 1890. Several small orders have been placed at Chicago. Considerable Southern business is in the market, part of which will probably go to Pittsburgh. Quotations remain in the East at $27@$27.50; at Chicago, $30@$30.50, and at Pittsburgh, $26.50@$27.50 for heavy sections.

Old Rails.—A few sales have been made in the east, quotations being $22.50@$23 nominally. At Chicago little business has been done, holders asking from $20@$20.50, which buyers refuse to meet. Pittsburgh has sold 650 tons of American tees at $22.50, and old rails are quoted at $17.50 and $20, according to length.

Track Fastenings.—Spikes sell at the east at $1.95@$2, and angle bars at $1.75@$1 80.

Continuous Steam Heating in Connecticut.

The Connecticut Railroad Commissioners announce a hearing to be held at their office in Hartford, May 8, to consider the question of heating passenger trains. Inquiries have been sent to the railroads for information about their present practice and for the opinion of officers concerning individual and continuous heaters. Manufacturers of continuous systems are also invited.

Manufacturing and Business.

We have received from the Chapman Jack Company of Cleveland, Ohio, a sample of their encased screw jacks, in which the oil is economized to an extent not possible with the ordinary forms of jack. The sample we have received is suitable size for a desk ornament, and yet it is so well constructed that it will lift four tons in weight. This lifting jack has met with much success, and it occupies a position in rapidity and ease of operation between the hydraulic and the ordinary form of jack, and can be furnished at an economical price.

Electrical.

The activity of the electrical inventor is well illustrated by the fact that on April 9 53 patents on electrical inventions were granted by the United States government.

The London Central Subway Railway Co., which is now applying for a charter before Parliament and has met with considerable approbation from English engineers, have issued a circular which describes the service intended to be performed by their company. The intention is to operate a road by electricity.

The operation of the Electric Street Railway in Boston, by the West End Company, during the latter part of last winter and so far this spring, resulted in what may be termed a fair success. The cars are more popular and are better filled with passengers than the horse cars. Besides traveling faster, horse vehicles are more ready to give it right of way and there are less delays in traveling over the line. It is stated by a Boston paper that the result as a whole has more than met the most sanguine expectations of President Whitney of the West End Company. Undoubtedly during the coming year the electric road in Boston will be extended. It is the intention to completely remove, as much as possible, horses from the street cars of Boston.

Increase of Adhesion by Electric Current.

It is still a matter of dispute as to whether or not the passage of an electric current between the wheels of a motor and the rails, increases the adhesion available for traction. In a recent issue of *Electric Power* is a brief account of a demonstration recently made in Washington. The experiment was conducted by Mr. Joseph Lyons. A pair of wooden strips were connected to form a frame and a pair of short parallel strips of sheet iron, set up edge-wise, secured to the frame, and a toy electric motor was arranged to move the miniature truck along the sheet iron rails. The experiment consisted in closing the motor circuit and then lifting the forward end of the frame until the grade was such that the motor could not climb it, that is, until the adhesion due to the weight of the motor was not sufficient to overcome gravity. On closing an independent circuit through the rails and truck wheels and shaft, the motor would start again up grade and travel a considerable distance. There was no mistaking the action of the motor. It was positive and pronounced, "like the scramble of an army mule" under the traditional stimulus. Mr. Lyons estimated the increase of traction at about 40 cent.

RAILROAD GAZETTE

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EDITORIAL ANNOUNCEMENTS.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting, and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

We print elsewhere an abstract of a special report of of the bridge expert of the Massachusetts Railroad Commissioners on the condition of the pile bridges of the state. At the request of the Commissioners he included in this report a summary of the known facts as to the action of marine animals on submerged structures and the means of preventing their ravages. This part of the report will not be new to most of our readers, but we have summarized it in another column, together with the newer matter, for the reason that it is a concise statement of information which all civil engineers, and indeed managers and superintendents, should have. There is singularly little new information as to the methods of protecting timber against the teredo and limnoria, but it appears to be true that coal tar creosote is the only effective treatment.

In a recent issue we called attention to the variations in the proportions of grate areas and heating surfaces to other parts of locomotives. In this issue we give a communication from a mechanical engineer and locomotive designer which contains certain information on this point, and we recommend the perusal of this communication to those of our readers who will be called upon by reason of their position to answer the letters of inquiry issued by the committee appointed by the Master Car-Builders' Association relative to this subject. We also append to "C.'s" letter the general dimensions of the standard Pennsylvania Railroad locomotives, arranged in the form of a table, one column of which, marked "Tractive force per pound of effective pressure per square inch on piston," corresponds exactly with the coefficients given in the large table by our correspondent. This table of general dimensions will serve to show the use of the table of co-efficients, and further serve to illustrate the impossibility of obtaining anything like a standard ratio between the total heating surface and the grate area. The difficulty is clearly seen when one notices that here are given the comparative dimensions of twenty classes of locomotives, each of which is, in its own way, at least, a good, satisfactory engine, and some of which are the best engines ever placed in American service, but no fixed ratio exists between their grate areas and any other dimension. It would be well to carefully consider these tables and proportions before completing answers to the questions contained in the circulars issued by the committee. We hope they will throw some light on the subject, and perhaps furnish information needed to assist in the completion of the replies.

Rail Joints.

The rail joint continues to offer an attractive field for ingenious inventors and the number of new devices constantly brought forward does not seem to diminish. Within the last two years several quite new joints, each having considerable merit in its own way, have appeared. At the same time the use of improved forms of the angle splice has extended. The joints now before the public may be classed in three groups: The angle splice, the bridge joint, supporting the base of the rail and carrying the load from one tie to the other; and the bridge joint, by which the load is transmitted by the use of an auxiliary rail placed alongside of the track rails.

The changes in the angle splice which have taken place in the last two or three years consist in the use of greater weight of metal, the substitution of steel for iron, the increased use of the long 3-tie splice and strengthening the angle plate toward the middle of the joint. Another modification which has been made, and which appears to offer certain advantages, is the use of a clip of some sort to hold the ends of the rail to the same level, in the case of the suspended joint, or of a means of fastening the ends firmly to the tie to accomplish the same purpose, in the case of the supported joint.

With the increase of weight in angle splices, breakages appear to have practically ceased, at least when they occur they are almost always attributable to other causes than defect in the principle of the joint. It has been the experience of those using a long splice, supported, that joints are broken, even with the heavy sections, through the slot for spiking to the centre tie. These breakages have ceased since that slot was given up. Breakages have occurred, also, from low ties in the middle of the joint and from defective ballast; also from poor material in the splices. When the 40-in. 6-bolt splice, with interlocking bolts for the centre tie, was first put down on the New York Central & Hudson River, some of the angles broke. The bottom flange was cut away to a considerable depth in order to allow the clip of the interlocking bolt to rest directly on the flange of the rail. The joint was then put down under heavy traffic before the centre tie was put in, and even after this tie was put in considerable traffic went over the joint before the tie was well tamped up. Since these defects have been remedied the splice has been very satisfactory, and presumably it will be even more so in its later form, in which the bottom angle is very little cut away. On the Erie also the long splice broke quite frquently through the middle slots, but it has ceased to break since that slot has been done away with. The universal testimony is that this form of joint, of proper material, with reasonable treatment, does not break. The same thing appears to be true of the suspended joint of heavy section.

In both forms of the angle plate joint there still remains the defect that the ends of the adjoining rails are not kept at absolutely the same level, and consequently the receiving rail is more or less battered by the wheels. This, of course, will occur with the supported as well as with the suspended joint, although perhaps not to the same extent. To remedy this difficulty a clip in various forms has been proposed for the suspended joint; and in the supported joint it is proposed to hold the ends of the rails firmly to the ends of the tie by the use of interlocking bolts. Both of these modifications appear rational, and will doubtless add to the life of rails.

Still, it seems probable that the 3-tie joint, supported, will give better satisfaction than the suspended joint, and will come into increasing use. The wider spacing of the bolt holes, which is possible with the long splice, will relieve the strains on the bolts to a considerable extent, and lessen the wear and motion there, and will, doubtless, diminish the wear on the top of the angle plate at the centre of the joint, for the reason that the rail ends are stiffened by the longer plate and will deflect less. The 3-tie joint also offers the additional advantage of a greater foundation in the ballast at that part of the track which is weakest, and at the same time permits the ties to be spaced wide enough for proper tamping. Whatever may be the arguments for or against the long splice joint, the most conclusive thing that can be said in its favor is that those who have used it most are those who are most convinced of its superiority; and since it has been made heavy enough to perform the functions that it is designed to perform, there is no disposition on the part of those who have used it in its latest form to abandon it.

Of the bridge joints several are now offered besides the well-known Clark-Fisher joint. The fundamental principle of this form of joint, that the weight should be received on the foot of the rails and transmitted equally to the two adjoining ties from the centre of the joint, is undoubtedly excellent, and in certain situations the joint has given great satisfaction. The only serious objections that have been raised to it are: First, that the foundation of the joint is only two ties instead of three. On the structures of the elevated road, where the foundation is solid and there is no ballast to yield or be displaced, this objection has less force than on surface roads. Second, an objection to the bridge joint has been found in the imperfect alignment of the rails. It is apparent that if the sections of the rails are not perfect and the base on which they rest true, there may be a variation in gauge line which will be serious. Third, in roads of heavy traffic this joint does not adapt itself so readily as the angle splice joint to the purposes of renewal of rails. With the angle splice a long stretch of rail can be laid alongside the rail to be replaced, the joints put on and bolted, and between trains the old rail slipped out and the new slipped into position, and, with a few spikes driven, the track is in condition to carry a train. With the bridge joint this method of relaying rails is obviously not practicable. Neither of these latter objections has, however, been found serious on the elevated roads, and may be comparatively unimportant elsewhere. Whatever weight they may have, about one-third of the track of the Manhattan is laid with the Fisher joint, and it is now the standard on that system.

The form of joint in which the load is carried over the joint by a supplementary piece of rail has been but little used, and nothing definite can be said about it in the light of practice. An experimental joint of this description was used for a number of years on a Western railroad, and is said to have given good satisfaction. Recently it has been reinvented, and will be brought again to the attention of railroad men in an improved form, in which it may be found meritorious. Many of the new joints and even the clip for holding the rail ends to the same level are reinventions, but under changed conditions, and with the important modifications made, they may now be found more valuable than they were in the past.

Regulation of International Commerce.

The most important and specific part of the Inter-state Commerce Commission's decision in the Grand Trunk investigation is contained in the following paragraph:

"Upon investigation by the Commission, it appears that the Grand Trunk Railway Co., of Canada, transports coal and coke under a schedule specifying a total rate from Buffalo, Black Rock and Suspension Bridge, in the United States, to Hamilton, Dundas and other points in Canada; that the published tariff rate for such transportation from the points named to Hamilton and Dundas is $1 a ton, but that it accepts a reduced charge or allows a rebate of 25 cents a ton in favor of certain consignees at Hamilton, Dundas and other points in Canada. Held: That the reduced charge accepted or rebate allowed is in violation of the act to regulate commerce, and unlawful."

That the result which the Commission seeks to attain is desirable, we have no doubt whatever. That it can be accomplished by a mere opinion of the Commission seems much less certain. The difficulties in the way are partly practical and partly legal.

The practical difficulty is the most obvious. How can the Commission prevent a road from paying rebates in Canada? It is hard enough to accomplish this result in the United States, where matters are wholly under the Commission's jurisdiction. The moment we pass a national boundary line things become still more complicated. It is easy to say that the transportation is a continuous thing, and that a personal discrimination becomes an offense punishable at any point on the route; but it is hard to see how the matter can be followed up so as to enforce this idea.

So great has been this difficulty that the United States courts themselves have shrunk from allowing state courts to apply the theory which the Inter-state Commerce Commission here adopts. In the decisions of the U. S. Supreme Court in the case of the *People of the State of Illinois vs. The Wabash, St. Louis & Pacific Railway Company*, the power of state commissioners and courts to assume jurisdiction over inter-state commerce was pretty strictly limited. The Iowa Commission, though disappointed at the decision, says explicitly: "It may now, we think, be regarded as settled by the highest authority binding upon all that the powers of the state as to regulation and control are confined to strictly domestic commerce, and do not extend to shipments from the state to points outside, or to shipments from points outside the state to points within. That such shipments are to be regarded as an entirety, and cannot be divided so as to deal with the portion exclusively within the state. *That discrimination made with reference to such shipments cannot be prevented, punished or re-*

MAIN ERECTING SHOP OF THE NILES TOOL WORKS, HAMILTON, OHIO.

strained by the laws of the state." Iowa Commissioners' Report, 1886, page 41.

If a state authority cannot regulate inter-state commerce, how can a national authority undertake to regulate international commerce in the same way?

We do not shut our eyes to the fact that it is desirable that such discriminations should be stopped. We wish that they could be. If we thought that they could we should be willing to sacrifice some of the logical development of transportation law for the sake of the object to be attained. But in the present case we do not see how the result can be thus attained. The denial of the right of individual states to exercise jurisdiction over inter-state traffic is closely connected with the absence of the power to enforce it. This power is still more conspicuously absent in the case of international traffic.

Whether the decision of the Commission stand or fall, it will be of service in calling public attention to the international character of some of the problems which are now before us. Our railroads are dealing, not simply with national trade, but with a part of the world's trade. We may destroy such trade, if we insist on so doing; we cannot effectively control it, except by common action on the part of different nations. We cannot believe that the former alternative will be chosen. We expect to see international agreement rather than destructive international warfare. In Europe much progress has already been made in this direction. Our relations with Canada and with England are likely to involve us in the same progress, whether we will or no.

Relative Economy of Cars of Large and Small Capacity.

In reply to a correspondent in another column who desires information regarding the comparative cost of transporting freight in heavy and light cars, we must state that there is but little accurate information in the way of statistics, but the following may be assumed to be a fair statement of the comparative cost of transportation under conditions similar to those he imposes. In order to render the statements of practical value and to reduce the labor incident to the calculation, we have thought best to use weights and carrying capacities more in accordance with actual practice on American roads.

In considering this subject the following propositions may be safely assumed to be practically correct as far as freight cars are concerned:

(a) The greater the number of journals used to carry a given load the greater will be the frictional resistance resulting from the load, provided always that the weight upon each journal, in the case of the smaller number of journals, be not so great as to prevent good lubrication.

(b) The greater the number of wheels used to carry a given load the greater will be the rolling frictional resistance, resulting from the load, within the limit of average railroad freight car loads per wheel. It is true, however, that an excessive load, such as would bend the rail considerably or tend to crush the metal of the rail or wheel, would cause more rolling frictional resistance per pound of load than if such excessive loads were distributed.

(c) Frictional resistance of journals and probably the rolling frictional resistance of wheels is considerably greater *per ton of load* for light than for heavy loads up to a point beyond the limits of average railroad freight car loads; that is, the friction is greater per ton of light than per ton of heavy loads on same journals and under otherwise equal conditions.

(d) The resistance of average freight trains may be considered as consisting of three elements, viz., Frictional resistance, resistance due to inclines and side wind resistance.

There are cases where the increased resistance caused by long trains on curves would render necessary the consideration of the length of train. But this, for the purpose of a discussion of the relative resistance of freight trains in the average, as well as the question of the increased cost of operation of long trains on either curved or straight lines, may be omitted for the reason that such considerations do not fall within the scope of the argument. And further the head air resistance is so small per ton of load in the low average speeds of freight service as to render its consideration a requirement not in keeping with the general character of this reply. Several other minor disadvantages resulting from long trains are not herein considered for reasons analogous to those just mentioned.

It is impossible to give concrete results of a consideration of the bearing of the propositions (a), (b) and (c) on this subject of small *versus* large carrying capacity of freight cars, but the following general conclusions with reference thereto can be drawn and are sufficiently accurate to be accepted for the purpose of this argument.

1. The journal friction of a given number of loaded cars having large carrying capacity, will, within the limits of railroad freight car loads, be less than the journal friction of a larger number of loaded cars having a smaller capacity when the total train load is the same in both cases.

2. The rolling friction of a given load on a number of cars having a large carrying capacity will be less than that of the same load on a larger number of cars having a less carrying capacity.

3. In general it may be assumed that the greater the load per journal, within the limit of average railroad freight car loads on average railroad freight car truck journals, the less will be the resistance to traction per ton of total load.

Regarding the fourth proposition something more definite can be stated. Frictional resistance of freight cars on level tangents or on level curves of large radius may be assumed to be about 8 lbs. per ton. If this is slightly too large or too small, the error in what follows, caused by this assumption, will not be material. The resistance due to grades depends directly upon their slope, and the comparison of the resistances per ton of a given paying load when carried in large or small capacity freight cars may be assumed to be nearly the same for all grades.

The resistance due to side winds is so great on our Western roads, and during certain season of the year on all roads, that it calls for special attention. The resistance resulting from side winds may be stated, without great error, as depending directly upon the side area of the train. The side area of a train of small capacity cars is considerable greater in proportion to a given total load than is the side area of a train of large capacity cars carrying the same load, because trains of small capacity cars, in order to receive the greater varieties of freight and for other and economic reasons, would probably have the same clear height, the same width, and in many cases, such as lumber and special cars, the same length for the same number of cars as a train made up of cars having larger carrying capacity. In addition to this there is a multiplication of the spaces between cars which tends to increase the length of the train of lighter cars. A good example of this is the comparison of the length of a 50 car train, consisting of 60,000 lb. cars fully loaded, and the length of a train made up of 40 000 lb. cars, carrying the same total load, the cars being such as are now made for general service.

Length of fifty 60,000-lb. cars over all, including spaces between cars, 1,875 ft. Total paying train load, 50 by 60,000 lbs., 3,000,000 lbs. Number of 40,000-lb. cars to carry same load, 75 cars. Length of seventy-five 40,000-lb. cars, including spaces between cars (cars as now generally built), 2,762 ft.

The side area of these trains are nearly, if not exactly, in proportion to their length; therefore, and almost as a direct consequence, the resistance resulting from a side wind will be greater in the case of the lighter cars carrying the same total load in the proportion of 2,762 to 1,875, or 1.4 to 1 nearly. The actual dead or non-paying load in the two cases is as follows:

Weight of 50 empty 60,000 lb. cars, 30,000 lbs. each, 1,500,000 lbs.

Weight of 75 empty 40,000 lb. cars, 24,000 lbs. each, 1,800,000 lbs.

In order to make a fair comparison of resistance in pounds per ton of paying load under the two conditions of 40,000 and 60,000-lb. cars, it is necessary to take notice of the fact that the average car load is not in excess of $\frac{4}{10}$ of the rated load.* Allowing for this average loading, the loads of 50 heavy and 75 light cars becomes about 1,200,000 lbs. The total train load in each case then becomes:

Fifty $\frac{4}{10}$ loaded 60,000-lb. cars, 2,700,000.

Seventy-five $\frac{4}{10}$ loaded 40,000-lb. cars, 3,000,000.

From this data comparative resistances per ton of paying load in 40,000 or 60,000-lb. freight cars, either on levels or on grades, resulting simply from the load itself, may be stated approximately. It may be well to add that a consideration of side wind pressure would materially increase the saving here shown as effected by the use of the large capacity cars which result in shorter trains.

On a level track, the following are the approximate comparative resistances of the same paying loads carried in the two classes of freight cars above mentioned:

Resistance of fifty 60,000-lb. freight cars, with 600 tons load, 10,800 lbs.

Resistance of this load in lbs. per ton paying load, 18 lbs.

Resistance of seventy-five 40,000-lb. freight cars, with 600 tons paying load, 12,000 lbs.

Resistance of this load in lbs. per ton of paying load, 20 lbs.

Decrease in resistance per ton of paying load, as result of using 60,000-lb. cars instead of 40,000-lb. cars, under these conditions, 10 per cent.

* See argument of Albert Fink before the Inter-state Commerce Commission.

Inflated Capital Accounts.

An investigation now going on in Minnesota discloses a systematic process by which large changes have been made in the book valuations of railroad property. We trust that the widest publicity will be given to this matter. The practice is a dangerous one. It is easy to begin and hard to stop; and when it has once established itself, it offers railroad directors and accounting officers every opportunity—not to say every temptation—to abuse it.

Perhaps the commonest reason for over valuation is connected with stock watering. If a railroad wishes to increase the nominal amount of its capital stock, it must change some other item to preserve the balance. If the road has an accumulated surplus, this is comparatively easy. The only thing necessary is to deduct from the surplus, or profit and loss balance, an amount equal to the increase in capital stock. The sum total of liabilities is thus maintained at its old figure, and no changes are necessary in the column of assets.

But most railroads are unable to adopt this expedient. Few of them have a sufficiently large accumulated surplus to be available for this purpose. If a road without a surplus is going to water its stock—which is not generally right, but sometimes convenient—the logical method would be to enter a corresponding deficit among the assets, under the head of profit and loss. This deficit could then be gradually reduced by appropriating undivided earnings to that purpose from year to year. But this practice is not popular; no accounting officer likes to have a deficit appear in his balance sheet if he can possibly help it. Still less does he like an annual reminder that a part of his earnings ought not to be used for paying dividends. It is less honest, but much pleasanter, to avoid the appearance of a deficit by an increased valuation of the assets.

There are a few cases where this can be done legitimately; some of the assets of a road are of the nature of securities, or of local real estate, on which it is possible to put an inventory value. But in the great majority of cases it is wrong in theory and dangerous in practice. The great mass of railroad property cannot be inventoried. It is entered in the balance sheet at cost; and at cost it remains, whether its value increase or diminish, unless it is crossed off altogether. If an attempt at re-valuation is made, the balance sheet loses its essential character, without really gaining that of an inventory. Under such circumstances the published accounts are worth nothing. All power of controlling or judging the action of the directors is at once lost.

If such a system of book-keeping is adopted that the officials appear to have spent money which they have never received, the same system, with hardly a change in its application, can be made to indicate that they have spent money which they have actually received and converted to their own uses. The same method of concealment which is used to deprive the public of insight into the affairs of the company may be used to deprive the stockholders of insight into the affairs of the officials. The only wonder is that we have not suffered more extensively from this cause.

Most of the actual harm has been done in another way. Any increase of valuation in the capital account makes the apparent amount available for dividends larger than it otherwise would be. If this practice has once come into vogue, the temptation to use it for this purpose becomes very great. It does not involve the appearance of personal dishonesty; it makes the management popular with the stockholders, and makes people ready to place additional capital in its hands. If two rival railroad systems adopt a method of book-keeping by which their apparent earnings are exaggerated, it furnishes a double inducement for railroad duplication. It indicates that there are future profits to be divided which really do not exist, and it makes people ready to invest their money on the strength of a false record as to the past.

It is no answer to say that the average capitalization per mile of road in the United States is slightly diminishing. With the amount of new and cheap road built, there was reason enough why it should diminish; and with honest capital valuations, it would have

diminished faster than it actually has. We are not among those extremists who say that our railroad capital is fully half water, and that anything in excess of $30,000 a mile is fictitious; but we believe that there has been a considerable amount of over-valuation, and that even a slight error in this respect may do vast harm in tempting the construction of a parallel road, to share profits which have no real existence. There is a close connection between inflation of Minnesota capital accounts and depression in Minnesota railroad property.

So great is this indirect effect, that we are inclined to think that the investors of the country would be better off to-day if the amount of disposable funds, which was secured by unfair valuation, had been fraudulently pocketed by the directors instead of being distributed in dividends. In the former case there would have been a direct loss once for all; in the latter there is a misjudged investment of capital and incurring of obligations whose evil effects may sometimes last for many years. If the Inter-state Commerce Commission, by its stringent requirements for information as to capital account, can do anything to prevent these errors, it may prove the most valuable part of its whole work. If investors really knew what they were doing, the problem of limiting railroad duplication would solve itself.

A National Law Requiring Uniform Freight Brakes and Couplers.

The desirability of Federal legislation looking to the adoption of uniform freight car couplers and freight train power brakes is discussed in another column by a correspondent who shows a good grasp of the facts in the case, and who gives a summary of interesting data which he has gathered. While the regulation of these devices has been generally regarded as a matter coming within the scope of police regulation, and is thus included in a class which the court decisions have uniformily treated as one over which the individual states have all the power they may choose to exercise, we may for the present agree with our correspondent that the general government may, if it be found desirable, pass a law requiring the adoption of automatic couplers and power brakes. But there is a question whether this is really desirable. At the outset we meet the fact that but a small portion of all legislation of this kind accomplishes its purpose and that government regulation involves more or less of a bureaucracy. Uniformity, which our correspondent concedes to be a prime consideration, can be enforced only by pretty arbitrary action. He evidently assumes that the M. C. B. type of coupler and the Westinghouse brake ought to be at once adopted universally. That, however, would be regarded by many as special legislation of the most objectionable kind. Such legislation as that which was had in Massachusetts concerning automatic couplers has done little good. The commissioners who have the administration of the law there have not found it practicable to do much, if anything, to advance uniformity.

It is true, as our correspondent states, that directors look at financial results, and that superintendents who realize the humanitarian considerations, cannot always influence the directors; but it is hardly fair to characterize the roads, as a whole, as apathetic. There are roads where the directors do listen to humanitarian considerations, and many where the active operating officers do have influence. We may admit that the prevention of misery and death by the adoption of improved brakes or couplers is treated as secondary to the financial side of the question, but yet the fact that the eventual money gain will be certain is now so fully realized that many managers, perhaps we may say the great majority of those on important roads, feel that they have full authority to adopt power brakes and automatic couplers whenever they can feel sure that such action will be effective for the purposes designed, and whenever they can get the money to provide for the outlay. Feeling for the men may be secondary, but it is positive nevertheless, and doubtless often powerful. Automatic couplers involve *added* danger during the transition period from the old to the new. Many intelligent managers hesitate at this stumbling block, and a law compelling them to jump over or get around it involves delicate points. Power brakes involve a large outlay of money, and this investment, moreover, must lie partially idle until sufficient cars are equipped to make it practicable to use the brakes. Like the question of the abolition of highway grade crossings in Massachusetts, where an expenditure of over forty million dollars is agreed on all sides to be desirable but at the same time impossible from lack of funds, the financial question is, simply, How can the money be raised? Take the case of a road in Iowa to-day. Its officers may be ready to spend $1,000,000 for these improvements at once, but their profits are reduced and their borrowing power gone. As in familiar illustrations elsewhere, their poverty compels them to be uneconomical. The state or the Nation, in reducing income and increasing expenses both at the same time, is tackling an important question of political economy and general prosperity, whatever may be said of the abstract right or wrong involved.

The question of the safety of the trainmen, while a grave one, and one which we would not for a moment make less serious to those who are inclined to ignore it, is nevertheless modified somewhat by considerations which our correspondent does not touch upon. Laws cannot make careless men careful nor keep them out of dangerous situations. The unavailing efforts of humane superintendents to make brakemen use sticks, in coupling with the ordinary link, have given evidence of this. In yard switching and in some circumstances on trains, men will still have to go upon the tops of cars even after we have power brakes. A considerable share of the 2,700 men killed never ought to have been in the situation where they met their death. If laws could avail, the railroads ought long ago to have been prevented from hiring boys for brakemen, and from putting new men at dangerous work without thorough preliminary instruction.

In all this we are not arguing against progress or denying the need of uniformity. But the difficulties must be considered. The rapid growth of the immense railroad system of this country in little over a half century has been accomplished on precisely the lines here held up as objectionable. Directors have been allowed to look solely at the financial side of the question, and, indeed, have been offered great inducements to do so. The great body of the law on the subject, as well as of the public sentiment back of it, is shaped with this view. The people have wanted railroads so badly that they have encouraged new lines as soon as the dollar-grabbing projectors gave assurance of success, without asking many questions about safety of life and limb. It has been assumed that the projector will have made all needful provision for that. But he has not, and it is the later managers, those who have taken the roads to run after they have become prosperous, who have put in force the safety devices and methods. Even they have had to develop strong courage to do this. The roads that have spent large amounts at one time for important improvements have generally had to trust to the future for the money to pay for their outlay. Most managers are now trembling in the presence of a widespread limitation of rates, which is their dread day and night. With that feeling generally prevelant, any effort to induce the adoption of improvements will be about as pleasant and successful as pulling a cat by the tail. A hundred enterprising managers are ready to join the managing director of one of the largest lines, who said the other day that he could readily solve a lot of these problems concerning safety, if he could only get rates high enough to provide the necessary money. If a law can be provided which will cause careless and narrow-minded directors to come up to the level of this progressive one, it certainly would do a good work.

The annual report of the Union Pacific shows an increase of gross earnings for the Union Pacific Company of 1.8 per cent., and for the whole system of 2.5 per cent. The increase in operating expenses and taxes was 12.5 per cent. for the company, and 8 per cent. for the system respectively, leaving a decrease in net traffic earnings of 11 per cent. for the company, and 7.3 per cent. for the system. The unfavorable result is attributed in the report largely to poor crops in Kansas and Nebraska. The amount of traffic, both freight and passenger was greater on the lines of the company as well on those of the system than in the preceding year, but rates were lower. On the whole system the receipts per passenger mile fell from 2.509 cents to 2.416 cents, and per ton mile from 1.422 cents to 1.281 cents. On the lines of the company there was also a reduction but somewhat less. The surplus fell off 3 per cent. in case of the company and 4.6 per cent. in case of the system. This seems to be entirely due to lower rates, except that the system had to meet increased deficits from the St. Joseph & Grand Island, the O. R. & N. and the Central Branch, to the amount of $832,000 in 1888 against $274,000 in 1887. The directors, in view of the decreased net earnings, conclude to defer the dividend which they had expected to pay, and henceforth put enough of the surplus earnings into a sinking fund to prevent any further increase of the debt to the government.

The heaviest rail in America is that of the Philadelphia & Reading, 90 lbs. per yard, of which we published a section Aug. 24, 1888. The Manhattan Elevated has adopted the same section, and will lay 1,000 tons this summer, and will use it for all renewals of rails, frogs, and switches hereafter. The section is 5 in. high and 5 in. base. The radius of crown is 12 in., and the head is 2¼ in. wide where the curves of the upper corners meet the sides. This departure will doubtless strike many as unnecessary, and possibly extravagant, considering the light locomotives of the elevated but the officers of the road are confident it will be justified in the economy of maintenance. Not only the rail itself will wear longer, but the whole structure will be benefited by the stiffer rail.

A correspondent who, as a drummer with a heavy trunk, travels over a large extent of territory in the West, complains that rough usage of baggage in that region is more common than ever, and is, in fact, well nigh universal. He "names names" and includes some of the best roads in his strictures. The limitation, introduced five or six years ago, by which no piece weighing over 250 lbs. will be transported, is strictly enforced, and yet trunks are dropped from the baggage-car door to platforms on a level with the rail, or nearly so, without anything whatever being done to break the fall.

As drummers' trunks are universally strong and well made, there can be no excuse for destroying them, and it must, therefore, be admitted that well-attested accusation like this go a good way towards justifying the prevailing reputation of the American Baggage-master as the American Baggage-smasher. There are various reasons why baggagemen cause damage bills for broken trunks, and some of them are not easily disposed of; but to cure this particular difficulty it is only necessary to provide a skid and have it used. An oak frame-work 16 in. wide and of sufficient length to touch the platform when it hangs from the baggage car door-way at an angle of about 40 degrees from perpendicular, and provided with irons at the upper end by which it can be hooked to the door sill, can be made for two or three dollars, and one would think that the satisfaction of pleasing the patrons of the road would be sufficient to induce every superintendent to furnish such an appliance at all stations of consequence, whether the baggageman demands it or not. For various reasons, however, baggagemen do not always ask for this simple aid to easy work, so that however easy it may be to make a few skids and distribute them along the line, it is not easy to get them used when made. It ought to be done, nevertheless. The car department has increased the strength of cars to correspond with the growing recklessness of trainmen on switching trains, and that is in a large degree the railroad's own business, notwithstanding the fact that as cars grow stronger the men come to handle them more roughly; but the fact that as baggage handlers become rougher the regular traveling men provide stronger and stronger trunks is no warrant for abusing those trunks. This is *not* wholly the railroad's business. Is it not as profitable to handle a passenger's baggage gently as to furnish him $5,000 worth of fancy woodwork and velvet to gaze upon as he rides, or to increase the speed 25 per cent. beyond an economical rate without raising fares? It is not easy to enforce uniformly among a hundred men the habit of using a skid regularly, for at the medium-sized stations there will be many trains at which it is not needed, and the baggageman's judgment must be trained to give the trunk instead of his own laziness the benefit of the doubt when a trunk is not very little nor yet very big. Neither can men be made to lug one skid to two or three different platforms, many rods apart. To have them used there must be enough of them. To make men move as slowly and carefully as the nature of the baggage demands, when there is only a space of two minutes in which to handle 25 or 50 pieces, is also hard, but as long as it is done in theory, why not have it enforced in practice a little more fully? To secure any of these points the division superintendent or the general baggage agent, or some one, must keep up a careful inspection, as much so as he does to make sure that the men wear clean white caps or refrain from smoking when on duty. As long as such a simple duty to passengers is neglected, so long will there be an undercurrent of ill feeling among passengers which it will require a great amount of rhetoric on the part of the general passenger agent to counteract.

The Legislature of Nebraska has passed a law permitting trains to run over a grade crossing of another railroad without stopping. The law is very loosely drawn, and was apparently passed without careful consideration, but it contains one provision which is quite novel in a law, so far as we are aware. Stops must be made as usual, "except where * * railroads maintain a semaphore and gate with torpedo attachment." * * Nothing is said about the approval of any board or other authority, and there is no requirement of interlocking. The "torpedo attachment" doubtless means some device like the Palmer torpedo signal, extensively used on the Manhattan Elevated, but the provision of even so good a safeguard as that, while leaving other points of danger wide open, seems a waste of money. What is wanted of gates when proper semaphores and torpedoes are used is hard to see.

The Boston "Merchants' Week," a scheme arranged between the railroads and the wholesalers of that city, whereby retailers in the surrounding country have been carried to the city for about half fare, for a week or two at a time, the last two or three seasons, is considerably interfered with by the more stringent attitude concerning excursion rates which the Inter-state Commerce Commission has assumed since the change in the law. Heretofore the time limit has been very

liberal, and, indeed, remains so now within Massachusetts; but the Inter-state roads will this season make tickets good for the going trip only on a single specified day each week of the two), and on specified trains.

It is said that on the inquiry concerning free passengers and the issuance of passes, which the Inter-state Commerce Commission has appointed for May 3, each of the roads summoned will be required to present from its records a true and correct list of all persons, if any, to whom it has issued free passes or free transportation who are not its own officers or employés or the officers and employés of other railroad companies, between Nov. 1, 1888, and the time of such investigation, if any of them have done such business, with an explanation as to how and why this was done in each instance; and the lists must be verified by proper proof. A Washington dispatch reports one of the Commissioners as saying that there are more complaints filed with the Commission relative to the issue of free passes in violation of law than for any other cause, and that some action has become necessary to arrest the evil.

Mr. James Forrest, Secretary of the Institution of Civil Engineers, sends to all members of the American technical societies who have taken passage by the "City of Richmond" and the "City of New York" for the European trip, a list of the reception committee of that institution. This committee is appointed to make arrangements for the visit of the American engineers to England in June. It is made up of members of all classes of the Institution, and contains about 200 names.

NEW PUBLICATIONS.

New Jersey: Fifth Annual Report of the State Board of Assessors. This report opens with a reference to the revision of the tax laws of the state in 1888 and the added convenience in the work of the board afforded by the change. The railroad and canal tax law has now been in operation for five years, and the board congratulates the state on the fact that the main questions in dispute concerning the working of the law have been settled by the courts, and that it is, as a whole, now working successfully. The board refers to the increase of railroads in the United States, and quotes the *Railroad Gazette's* table of new mileage in 1888.

"The value per mile of the railroads of New Jersey is greater than that of those of any other state." Nine new roads have been incorporated, and all are believed to be bona fide enterprises for which there is a real need. The mileage of road in the state is 1,977½. There are 564½ miles of second track, 139¼ of third and fourth track and 965 miles of side track. There are 2,395 miles of track laid with steel rails. The mileage of canals and feeders is 173. The capital stock of the roads of the state is $117,457,285 and the funded debt $143,109,781, both together being $132,070 per mile of road. The valuation of road, franchises and tangible property used for railroad and canal purposes is $196,363,694, on which the tax is $1,316,283, an increase of $53,390 over the previous year. The gross earnings from freight and passenger traffic for the year ending Jan. 1, 1888, amounted to $34,472 532, an increase of $2,431,115 over the previous year. Besides railroad and canal property the board levies assessments on miscellaneous corporations, of which there are 1,457, and against which $390,198 is assessed. Many of these corporations have no substantial existence, however, and the amount of tax collected is not by any means commensurate with the assessments. Attention is called to the fact that the large express companies are partnerships having no corporate existence and that they therefore escape taxation.

Scribner's Magazine for May contains the tenth Railroad Article of the series begun last June. It is by Theodore Voorhees, Assistant General Superintendent of the New York Central, who has given us an exceedingly well written article on the movement of freight, the car record office, and the evils which it is expected per diem and demurrage will in the near future cure. Mr. Voorhees opens with a chapter which will appeal to the average reader with the interest of a mild romance, though it gives only the true story of a car that eluded tracers for 16 months. The description of the Car Accountant's office is a first class argument to be read by superintendents who have not yet given that office the position its importance deserves, but the general reader will, we fear, find it slightly dry. The main portion of the article describes the handling of freight cars in yards, the principles governing loading and switching, the mission of the fast freight lines, etc. The illustrations are all taken from freight terminals in New York City and vicinity.

The *Journal of the Association of Engineering Societies* for April contains five articles, all of considerable importance. The first one is the History of a High Viaduct, by Mr. S. D. Mason, Principal Assistant Engineer of the Northern Pacific Railroad. It describes the Marent Gulch viaduct across the gulch of that name in the foothills of the Rocky Mountains. Another paper in the same issue is Wrought-iron and Steel Eye-bars, by Mr. Carl Gayler, of St. Louis, giving some discussion of the manufacture and characteristics of iron and steel eye-bars and an elaborate table of tests of steel eye-bars for Grand Avenue Bridge, St. Louis, Mo. The Quaker Bridge Dam, by Prof. William A. Pike, of the University of Minnesota, is a brief review and discussion of that project. Another paper of considerable length is Smoke Prevention, by Mr. Robert Moore. Mr. N. S. Possons contributes a paper on Recent Improvements in Electrical Transmission, which is discussed by members of the Cleveland Club. The usual index to current literature is given.

The *Transactions* of the American Society of Civil Engineers for November and December have appeared. The November number contains a paper by Mr. James D. Schuyler on the construction of the Sweetwater Dam in San Diego County, Cal., illustrated by several heliotypes, plans, profiles, etc. This paper is also discussed by various members of the society. The same number contains Col. Craighill's paper on the improvement of several rivers on the Atlantic Coast, with discussion. The December issue contains a paper on the plant and material of the Panama Canal by Mr. William Plumb Williams, which is elaborately illustrated, and a short account by Mr. J. A. Bensel of a new transfer bridge at Harsimus Cove, Jersey City, with discussion by several members. A note on this bridge is given elsewhere.

We have received the proceedings of the fifth annual meeting of the Iowa Surveyors' Association and of the fifth annual meeting of the Iowa Civil Engineers' Society, now consolidated and re-organized as the Iowa Society of Civil Engineers and Surveyors. Besides the minutes of the meetings the pamphlet contains the constitution and by-laws and list of members, also a paper on Waterways, by E. M. Gilchrist, C. E.; on Stone Arch Bridges, by M. Tschirgi, Jr.; on Land Surveying in Pennsylvania, by James McClure, and a paper entitled Some Paradoxes, by Seth Dean.

Friction of Locomotive Slide-Valves. By John Audley Frederick Aspinall, M. Inst. C. E., with an abstract of the discussion upon the paper. This is an excerpt from the minutes of the Proceedings of the Institution of Civil Engineers. Mr. Aspinall has given a description of experiments he has made to show the amount of friction of locomotive slide-valves under various conditions. Some of the valves were large, others small, some balanced and others plain. The paper is well illustrated, and contains valuable tables of results.

TRADE CATALOGUES.

The twentieth edition of *Steam, its Generation and Use*, issued by the Babcock & Wilcox Co., New York City and Glasgow, is quite a treatise on steam engineering, coupled with a catalogue of the Babcock & Wilcox boiler. It is a very handsome volume of 120 pages, containing many interesting and valuable illustrations. In this publication are embodied descriptions of some of the recent departures in steam engineering The properties of saturated steam, the heating of water at different temperatures, saving of fuel by heating of feed water, the heating value of various combustibles, temperature of fire, horse power of boilers, science of chimney construction, heating by steam, super-heating steam, economy of high pressure steam, and the care of boilers are topics which are well treated therein.

Ventilation and Heating is the title of a most useful pamphlet issued by the B. F. Sturtevant Blower Manufacturing Co., Boston, Mass. There is probably no collection of information relative to blowers and steam heating which contains a greater amount of information, with results from practice, than this pamphlet.

Wooden Pulleys.—Puster Bros., 44 South Canal street, Chicago, issue a catalogue, with dimensions, of wooden split pulleys. Wooden pulleys are being extensively used, and in many cases are more satisfactory than iron ones. They are more readily applied, and seem to have no disadvantages when well made. The pamphlet includes a price list of the hangers and attachments in general use in machine shops.

The Richmond & Danville Railroad Co. issues a catalogue of the minerals and woods in the region of the states of Virginia, North and South Carolina and Georgia, adjacent to their lines. The object of the circular is to indicate the mineral resources of the South, particularly in the region of the Richmond & Danville. This circular is compiled by Professor Kerr, Geologist of the state of North Carolina, and contains much useful information.

Injectors.—The Rice Manufacturing Co., 116 North Ninth street, Philadelphia, issues a small pamphlet showing the various injectors and ejectors and the boiler washing and testing apparatus made by that firm. The cuts are mostly new. This company makes both open and closed injectors, the "little giant," "fixed nozzle" and "unique" being well-known examples of the two types. All these injectors are made to standards, so that duplicate parts can be supplied cheaply.

The Safety of Pile Bridges.

Our readers will remember an accident which took place at the Boston terminus of the Fitchburg Railroad on the 23d of July last. A portion of a pile structure which was used for a side-track for the storage of cars gave way under two empty passenger cars, the ends of which fell through into the water, together with some of the flooring of a car shed adjoining. In this accident a brakeman was thrown into the water and drowned, but no other personal injuries occurred. The accident led to a careful investigation, under the orders of the Massachusetts Commissioners, of the pile bridges on the railroads in the State and is the subject of a very elaborate report by Prof. George F. Swain, engineer to the Board, which is published in the last annual report of the Commissioners.

Prof. Swain says that a portion of the bridge in question beneath the track known as No. 4, had several days before the accident shown signs of weakness by a settling of the track for three or four inches. The track had been raised and work had been begun in strengthening the pile substructure. The examination of this substructure had been confined to the portion above low water. It had been found that one of the caps or girders, by which the piles in one bent are tied together, had settled several inches. It was supposed that some of the piles beneath were weak, or that the load was not well distributed. It was proposed to strengthen that bent of piles by adding two new girders under the old ones, one on each side, each girder to be 7 by 14 in. and 36 ft. long, shoulders to be cut on the piles to carry them and bolted through. Wedges were to be inserted between the new girders and the old ones to take part of the load off the old girders. The girders were being put in place when the accident occurred. The wedges had not all been inserted and the bolts fastening the new girders to the piles had not all been put in. It appears probable that the strength of the structure had not been materially altered.

At the point where the failure occurred the bridge is very irregular in construction. The portion under the main track was built about the year 1854, as was that which gave way, but the various parts of the structure had not been well tied together. It is probable that some parts of this structure were portions of the original bridge which was built in 1828. It may be stated here that the piles in the greater part of this old bridge remained in place from 1828 until 1884. It is probable that the weight to be carried was not at all uniformly distributed, but that some piles were loaded much more than others. The stringers of this structure were covered by a close flooring of 6 × 6 in. white pine, carrying a covering of gravel and clay nearly 3 ft. thick, upon which the tracks were laid. The dead load amounted probably to at least 400 lbs. per sq. ft., and perhaps more when the earth was saturated with moisture. This would bring a dead load of over 12 tons (probably in some cases 15) on some of the piles. It may be confidently asserted that the load on some of these piles was much in excess of what they could safely carry, this excess being principally on account of the great dead load due to the gravel filling.

This bridge was examined twice a year by Mr. Turner, Chief Engineer of the Fitchburg, who was under it in April preceding the accident and noticed nothing defective. It was also examined every week by a bridge foreman or carpenter. These examinations, however, were confined exclusively to the parts above low water. The piles under the main tracks west of the draw, which are nearly all of white oak, were examined by a diver last fall, and with two exceptions were found in perfect condition. This probably led to the inference that those east of the draw near the station were in equally good condition. With regard to the portion below water, however, the examination which has recently been made has shown that the previous inspection had been insufficient; that some of the piles were in dangerous condition and not capable of carrying any load. This latter examination showed that ten piles under the main tracks were broken or sprung. Five of them had already been reenforced by additional piles and five had been in no way strengthened. In the bent which gave way one broken pile was found, the greater portion of the break being old. In the next bent north of it one oak pile was found which had been entirely eaten off by marine animals. Under the former car shed and drive way a number of birch piles and one oak pile were also found entirely eaten off. These were a part of the old Beverly street bridge. None of the piles driven in 1854 were found worm eaten, although some of them were broken.

Professor Swain's conclusion with regard to this accident is that it was due primarily to the giving way of the piles. This was due to one being entirely eaten off and one other partly broken. The disaster was hastened by the fact that the covering of earth and clay saturated with moisture was such as to load the piles beyond their proper limit, and that the portion which yielded was not well connected with the rest of the structure. The cause of the old break in the pile cannot be stated. The defects which were the primary cause of the accident would have been discovered by examination by a diver.

Since the accident the company has been engaged in rebuilding all that part of the bridge under track No. 4 and the old car-house. New piles have been driven and a new floor put on without any covering of earth.

The occurrence of this accident raised some doubts as to the condition of the pile bridges over the Charles River and in other parts of the state. Letters were therefore addressed by the Board to most of the railroad companies, calling attention to the matter, and requesting from them a detailed statement as to what inspection they made of their pile structures, and further that inspections below water should be undertaken without delay. The reports of the companies are given in Professor Swain's communication.

Mr. E. K. Turner, Chief Engineer of the Fitchburg, reporting on the bridge and wharf over the Charles River, says: The piles are nearly all of white oak and generally in good condition. East of the draw 10 piles were found broken or sprung, and of these five had been strengthened by driving additional piles and connecting the old to the new by hard pine girders. Under the car house and drive way a number of old piles were found to have been eaten by small worms, just above the bottom of the river, so that but a small portion of the original structure was left. The greater part of the structure was so built that all of the timber would be covered with water at high tide, and the structure was covered with gravel and clay to a depth of from 2 to 4 ft. This covering made a load of, in some cases, as much as 10 tons per pile. Mr. Turner recommends that in the repair of the structure all earth be left off except on the drive ways, where there should be just enough to hold the paving. He has seen nothing to justify the fears expressed at the time of

the accident that the pile structures belonging to the road have become weakened by the action of worms in the piles.

The Chief Engineer of the Old Colony, Mr. G. S. Morrill, stated that, with the exception of the bridge over the Taunton River at Somerset, all the bridges examined were found in perfect condition under water, and not a sign of the action of marine animals was observed. The bridge at Somerset, and one other in that neighborhood are exposed to the ravages of the teredo, and a certain number of piles have had to be replaced each year. The company has the Somerset bridge examined annually by a diver, and drives sufficient piles each year to keep it in safe condition. This year 29 new piles were required.

The pile structures of the Boston & Albany, which consist largely of wharves, are not regularly examined by divers, as the greater portion of the piles is entirely exposed at low water of spring tides. In August, 1888, however, an examination of all pile structures of the company was made by a diver. It was found that about 400 piles had been attacked by marine animals, and at least 150 were badly eaten.

Mr. H. Bissell, Chief Engineer of the Boston & Maine, reports that of the bridges of that company over the Charles and Miller's Rivers, 82½ per cent. were quite sound below high water. Four piles were badly eaten and the rest showed slight traces of the work of marine animals.

On the Boston, Revere Beach & Lynn the piles are subject to the attacks of marine animals, and spruce piles are eaten so as to be in a dangerous condition usually in from five to six years. The company reports that it was the intention last fall to replace from 100 to 200 piles, partly on account of having been eaten, principally because of decay at the top.

Some extracts of the report of Mr. Jackson, City Engineer of Boston, on the condition of the city bridges, are added as shedding some further light on the subject of life of such structures and the action of marine animals. An examination was made during August and September pursuant to the orders of the Board of Aldermen passed after the Fitchburg accident. The piling of portions of over 11 bridges was examined by divers and substantially no damage by the limnoria was found, except in two cases, which were previously known. The Rainsford and Deer Island wharves, however, were both found to be seriously damaged, and Mr. Jackson recommends that examinations should be made at intervals of one or, at the most, two years. The removal of the sewage from the South Bay has increased the activity of the limnoria by clearing the water.

Prof. Swain devotes considerable space to a consideration of the strength and safety of pile structures and their liability to decay, and to injury by the action of marine animals. There are on the railroads in the state 141 pile bridges, with a total length of very nearly 10 miles. A pile bridge, if properly built, is very satisfactory. It is easy of inspection, and its strength may easily be made sufficient, and it may be readily strengthened or re-enforced. The number and attachment of its parts are generally such that the failure of one does not necessarily entail the destruction of the entire structure. A pile may be completely eaten off and yet the girders may be and should be sufficient to transmit the load to the adjacent piles. Although the first cost of such a structure is less than that of a stone or iron bridge, its cost for maintenance and renewal, like that of all wooden structures, is relatively large.

The strength of such a structure is determined by that of the stringers or of the piles. The stringers may be easily computed by ordinary rules, and the practice with regard to them is tolerably well defined. The girders or caps simply serve to equalize the loads on the piles, and are not generally subjects for calculation. They should be, however, sufficiently strong in most cases to allow of the complete failure of a pile without the collapse of the structure. The strength of the piles themselves is the most uncertain element, since it depends principally upon the character of the foundation. If the piles are long encugh to reach a firm stratum they may support the imposed load by acting as columns. The crushing strength of the piles is generally much larger than the loads imposed, but in the case where a pile is supported by a friction on its surface the load which it can sustain is very uncertain and a much greater variation exists than in the case of a column, owing to the differences between different foundations. In such cases the sustaining power of the pile must be known from previous experience in the same or a similar locality, or some rule must be made use of based upon a close observation of the behavior of the pile when driven and of the amount that it yields at each blow of the hammer.

The durability of a pile structure depends largely upon the conditions to which it is subjected. If permanently submerged it is practically indestructible unless eaten by marine animals. When it is constantly dry, with a good circulation of air about it, it will also last for a very long time. As a means of preventing decay of the top of a pile structure, all or nearly all of the wood work is sometimes placed so low that it would be submerged at high water, as was the case with the Fitchburg bridge. While this method of construction increased the life of the girders, etc., and the covering of earth serves to distribute the load, it has disadvantages which entirely outweigh the advantages, viz., that the weight on the piles due to the earth covering is very large, and inspection is made difficult. Under ordinary circumstances, when there is no trouble from marine animals, a well built pile structure requires little or no attention for from five to ten years, and it should not be necessary to entirely rebuild it for perhaps twenty years.

Professor Swain goes at some length into the natural history and habits of the teredo and limnoria. The former animal requires rather warm water, and while there is evidence that it works the year around on the Gulf coast of Texas, it is said that at Norfolk there were no traces of it before June 20, nor any evidence of its beginning to work after Sept. 29. The rapidity with which timber is destroyed by it depends upon the number and activity of the animals. In the Gulf of Mexico piles 14 to 20 in. diameter, for a railroad bridge, driven in the spring were eaten so that they broke off in the following November, and others driven in June and July commenced to break in the following winter. Heavy yellow pine piles were so destroyed in a few months that a man could break them off, though many exceeded 18 and 20 in. diameter. In Delaware Bay, near the Capes it is stated that a pile is practically destroyed in three years. Although the teredo abounds on the Atlantic coast as far as Vineyard Sound, it does not appear that it ever goes north of Cape Cod.* It thrives best in clear salt water, and avoids waters which are brackish or contaminated with sewage or other refuse. This rule, however, is subject to exceptions, as the teredo has been found in harbors where the water is quite impure. The teredo works for a short distance above low water, and appears to go down 40 or 50 ft. below. It has been found 18 in. below the mud line. Timber which has been seriously injured by the teredo generally shows outward evidence of the fact. When it bores near the outside of the wood, such a thin partition is left between it and the water, that the action of the waves or of floating bodies, soon breaks the barrier.

The limnoria occurs all along the shore from Long Island Sound to Nova Scotia. It is said to work in a pretty narrow zone above and below high water mark. Probably the wharves and other submerged wood work in all seaports from New York northward are more or less injured by this creature, and the damage would be found surprisingly great if it could be accurately ascertained. This little animal, apparently the only one which causes trouble north of Cape Cod, abounds in Massachusetts Bay. It prefers clear, salt water, but is found in water somewhat brackish. It appears to dislike sewage as well as the refuse from gas works. Mr. Turner states that these animals formerly did considerable damage in the Charles River, but since the gas works were built little trouble has been experienced from them. The general testimony of the railroad companies and of the city engineer is, that at the present time the bridges in the Charles River suffer no great damage from the action of the limnoria. In fact, it is stated on good authority that an oak pile driven in the Charles River will last longer below water than above, and the West Boston bridge has oak piles which were driven in 1792. Spruce piles, however, are destroyed with considerable rapidity. In East Boston the spruce piles lasted six or seven years and at the end of that time were practically gone. In that region the limnoria generally eats off piles only a few feet above the bottom, and the range of action seems to be from the bottom nearly, or quite, up to low water. On the shores south of Cape Cod the limnoria is probably present but does less damage than the teredo.

Prof. Swain considers the remedies that have been tried for protecting timber against these animals, which he divides into the use of external surface coverings, and the application of processes by which certain poisonous or preservative substances are introduced into the wood. The bark has been found to be quite efficient against both animals as long as it remains entire, but this is necessarily a very unreliable protection. Another method which has been quite effective consists in charring the surface, which produces an outer material too soft for the animal to work in. This process, however, is liable to the same objection as reliance upon the bark—that is, that it may soon be worn off. Artificial coverings of metal, felt, canvas and even thick paper have been tried and found effective for a time. These protections are efficient as long as they are intact, but soon become valueless.

With regard to the injection of poisonous or other substances into the wood, it may be stated that the only method which has proved effectual, is the injection of a sufficient quantity of dead oil, or coal tar creosote. Impregnation with inorganic salts has again and again proved valueless. Simply as a protection against marine animals, Prof. Swain knows of no experiment or authoritative statement with regard to the quality of oil which is most effectual. The quantity of creosote required, also, will depend upon the numbers and activity of the animal. Efficacy of creosoting appears to depend simply upon the fact that it is distasteful to the animal. From which follows that it makes little or no difference whether the centre of the pile is penetrated by any oil or not, so long as the surface is penetrated to a certain depth. What this depth should be cannot be stated. It follows also that all cutting and framing should be done before treatment, except in open porous timbers which are thoroughly saturated.

For much of the material which Professor Swain uses in that portion of the report which bears upon preservative processes he acknowledges his indebtedness to the valuable and well-known report made some years ago by a committee of the American Society of Civil Engineers.

In conclusion it is recommended that pile bridges should be thoroughly inspected above water every six months and an examination of the submerged portions made by diver at least once in two years, and preferably once a year.

*An animal supposed to be a teredo is very destructive to timber in the Bay of Fundy and adjacent waters. The limnoria is also found there.—EDITOR.

TECHNICAL.

Harsimus Cove Transfer Bridge, Pennsylvania Railroad.

The December issue of the *Transactions* of the American Society of Civil Engineers contains a short paper by Mr. J. A. Bensel, read Oct. 3, 1888, describing a counterbalanced bridge for transferring cars from the shore to a float. The bridge had at the date of the paper been in use six months and was working satisfactorily. The bridge is a Howe truss 71 ft. long over all and 29 ft. in width, connecting the pier with an apron 25 ft. wide, across which floats are loaded or unloaded. The end movement of this apron is controlled by a friction gearing, the friction being sufficient to hold the apron in position when not attached to a float, and yet allow the desired movement. These bridges are placed near the north boundary of Jersey City, where the shoaling of the water occurs very rapidly and pontoon bridges cannot be kept in position more than a year, when they have to be removed for dredging. The other advantages of this type are: They are easily adaptable to any height of float, the prevention of warping which occurs with a floating bridge when a heavy load is taken along one side without loading the other, and the fact that the bridge is always above water and not troubled by ice. The end of the bridge rises and falls about 10 ft. between its extreme positions. It is raised and lowered by steam power. The apron is counterbalanced and can be raised by two men, and is generally kept a little above the height of any float.

A New Method of Sawing.

The Egan Co., of Cincinnati, announces that it will give to those interested information of a new method of producing lumber, by means of which a better product can be had at a saving of time, lumber and expense.

Another Bicycle Locomotive.

It is expected that the second bicycle locomotive now building at the Portland company's works, Portland, Me., will soon be ready for trial. The new engine will be quite different in construction from the first. It will resemble an iron car 16 ft. long, 7 ft. 4 in. high, and 49 in. wide. The door of the cab is midway of the car's length, and the top of the boiler projects 6 in. above the roof. One man will act both as fireman and engineer. The tender is 8 ft. long, 7 ft. 4 in. high, and 49 in. wide, and the water tank is under the coal space.

Electric Railroad in Topeka.

The Topeka Rapid Transit Railway, the equipment for which has just been finished by the Thomson-Houston Electric Co., was put in operation on April 3. This is the longest electric railroad in the world (14 miles, 20 miles of track), and one of the finest electric in the West. The trial trip was made on Wednesday, April 3, with four cars filled with invited guests.

The power station is a two-story building, 100 ft. front, and 85 ft. depth, and has a 125 ft. chimney. The power plant consists of two Corliss engines of 600 and 300 H. P. respectively, steam for which is supplied by five boilers, 6 by 16 ft. The electrical apparatus consists of six 80 H. P. Thomson-Houston generators, with switch board and all necessary appliances.

Fast Time on the N. Y., P. & B.

The Shore Line Express which leaves New York at 5 P. M. and is timed to run to Boston in 6 hours, ran from Groton, Conn., to Providence, the length of the New York, Providence & Boston road, 62½ miles, in 68 minutes. The train consisted of five cars and was hauled by engine 34, which has 18 × 24 in. cylinders, and 6 ft. drivers. The speed had to be slackened at two junctions. It is said that one stretch of six miles was traversed in five minutes.

The Tehuantepec Ship Railway.

At the regular meeting of the New York Academy of Sciences, April 22, Mr. John C. Henderson read a paper on the proposed Tehuantepec ship railway. Mr. Henderson's paper was followed by an interesting discussion. Gen. Andrews said that canals had played a conspicuous part in past history and even now they have not fallen into disuse, and in countries of a lower grade of civilization, such as China, they are the chief arteries of commerce. It is estimated that the traffic on the canals of China equals or perhaps exceeds the combined commerce of all the rest of the world. But progressive nations are abandoning canals and substituting railroads. Experience proves that railroads can work cheaper than canals. If New York State should fill up here Erie canal and build a four track railroad she could haul freight over it cheaper than the canal boat can carry it. Estimates which he regards as incontrovertible show that a ship can be hauled by a locomotive over a ship railroad, or as he prefers to designate it a ship tramway, with the expenditure of only one-half the amount of coal which the same ship must burn to propel herself through the water of a canal.

The most frequent objection urged against the practicability of the scheme is that it would rack the ship; but Gen. Andrews explained that the weight is so distributed among the numerous supports that no one need sustain a greater weight than a man presses upon his foot in walking. The gradients of the route will be very slight, not exceeding two inches in 400 feet, the entire length of a vessel. He had made observations during a voyage aboard the steamer "Britannic," to measure the amount of strain to which she was exposed in a sea of no very great roughness, and found by stretching cords that the steamer was bent 16 in. by the waves, but without the slightest injury. Hence he infers that the stress on a vessel in crossing the isthmus would be inappreciable and harmless. A powerful argument he holds in favor of the Tehuantepec route is that it is the nearest to this country, and is in the region of winds, so that sailing vessels could use it, whereas Panama is almost a dead calm, and even Nicaragua is not to be depended on by sailing vessels. The result of opening either of the southern routes, therefore, would prove to be as the Suez canal has already proven, that the route would be monopolized by British steamers, and that the American flag would not be seen.

President Newberry said that the proposed scheme appears to be practicable, but that it is so novel as to seem to require the test of experience before we can be certain that all practical difficulties will be successfully met. The smaller ship-railroad from the Bay of Fundy to the Gut of Canso is being rapidly constructed, and will probably be in operation by about September, 1890. The results will be watched with interest, and if successful, the larger work at Tehuantepec will undoubtedly soon follow.

Crossing Gates and Foot-guards in Ohio.

On the 15th of this month an act was passed by the General Assembly of Ohio, amending the statute empowering the Commissioner of Railroads to require gates or flagmen at dangerous crossings. By the amended act when, in the opinion of the Commissioner public safety requires that gates should be erected and maintained, or that a flagman shall be stationed at a crossing, he shall give notice thereof to the officers of the railroad. The railroad company shall put in service a gate with attendant, or a flagman, within the time prescribed by the commissioner. Any refusal to comply with the terms of the order subjects the railroad to a penalty of $100 and a further penalty of $10 a day until the order is complied with. Gates under the direction of the Commissioner shall be built and located according to his approval, and shall be so constructed as to prevent passage across the railroad when closed. There shall be a person in charge at every gate, and it shall be his duty to close the gate on the approach of a train and to keep it

open at other times. For every neglect of duty the gateman is subject to a fine of $25. When more than one railroad is concerned in a single highway crossing, the expense of gates or flagman shall be shared equally by the different roads. Commissioner Cappeller has issued a circular to the roads announcing this law. He has also notified the roads of the new law by which each company on filing its annual report must pay to the commissioner a fee of $1 per mile of *track* operated within the state. The penalty for non-compliance is from $1,000 to $5,000. The attention of the roads is also called to the law of March, 1888, requiring frogs, switches and guard-rails to be provided with foot-guards. The commissioner holds that the blocking required by this law "should be of timber, cinder, gravel or of earth; timber preferable."

A Boiler Manufacturers' Association.

The American Boiler Manufacturers' Union was formed at Pittsburgh, Pa., April 16, at a meeting attended by about 100 boiler manufacturers from all parts of the country. The object of the organization is to prevent the use of materials of an inferior quality, and Congress was asked to make it a criminal offense to manufacture or sell iron or steel boilers of an inferior quality. The next meeting will be on Oct. 16 James Lapham, of Pittsburgh, was elected President, and A. T. Douthett, of Pittsburgh, Treasurer.

THE SCRAP HEAP.

Notes.

Vice-President M. H. Smith, of the Louisville & Nashville road, has ordered plans prepared at once for the construction, this summer, of a $100,000 passenger station at Tenth street and Broadway, in Louisville, Ky.

The Cumberland Valley road has fitted up a car with two powerful dynamos with a boiler and engine, for use as a traveling electric light plant for use at wrecks, etc. It is provided with poles and wires for temporarily lighting a considerable area.

A masked burglar entered the express office in the Wabash Western station at Pattonsville, Mo., on the night of April 20, and placing a pistol at the head of the express agent, compelled him to open the safe. The robber then disarmed his prisoner and took $6,000 out of the safe. The robber made the agent face the wall, and while he covered him with the pistol in one hand, bound him with the other and then escaped.

Judge Laubie, of Mahoning County, Ohio, recently set aside a $20,000 verdict against the Pennsylvania Company for injuries received by a commercial traveler, and in making the decision he took occasion to refer to the unenviable reputation of the county for heavy judgments, which had resulted "in bringing from surrounding states a flow of these damage suits into this county, and making it an Eldorado, a land of gold open for people who have been injured on railroads."

The Chicago & Alton has issued an order that when stock is loaded at local stations, in cars which are bedded with straw, hay or other inflammable material, and it is necessary to take the car or cars next to the engine, on account of using air-brakes, the bedding must be dampened. This will apply to cars of stock placed in the train four or five cars back from the engine; and the bedding must be dampened before leaving the loading station. In all cases where practicable sand should be used for bedding stock cars.

Rights of Minority Stockholders.

Some thoughtful person has suggested a discussion among lawyers of "the rights of minority stockholders and what legislation, if any, is needed for their protection," and accordingly the governing committee of the New York bar has offered a prize of $250 for the best thesis, argument or work upon that subject submitted by members thereof. Here is a field wide enough for the ripest legal talent to exploit itself in, and there is a vast army of individual and lonely stockholders who might be glad to contribute toward a reward for a solution of the question. Under existing law they have redress for almost any actual wrong in the courts if resort is had to that costly and tardy source, but actually they are a disorganized and helpless lot, the playthings of dishonest managers. What is needed first, however, is a disposition on the part of minority and scattered stockholders to help themselves and regard more critically the management of their property. It is their ineffable sluggishness and lamb-like confidence that more than anything else has yielded the experience that has been so costly. They have serenely allowed their agents to become their masters. Legislation cannot protect people who insist upon handing their purses to strangers and going to sleep. But beyond all this is an urgent problem to be solved relating to the corporate structure as at present framed.—*Springfield Republican.*

New Shops.

The work on the new shops for the Nashville, Chattanooga & St. Louis, at Nashville, is being rapidly pushed. The stone work is nearly completed, and the contract for the brick work has been let. Bids for the wrought iron work for the roof structure have been invited. There are nine buildings in all. They are to be of stone foundation, brick construction, with iron roof. The round-house will not be erected this year. The buildings now in course of erection are the machine and erection shops, boiler and tank repair shops, blacksmith shops, foundry, planing-mill, coach erecting shops and freight car erecting department. The buildings vary in size from 60×200 ft. to 100×250 ft. The planing-mill and storage department buildings are each to be two stories high. The expenditure on the whole plant will be about $250,000.

Burning of New York Central Elevators.

The two large grain elevators of the New York Central & Hudson River railroad at 60th street and the North River, New York City, were destroyed by fire on the evening of April 19, together with other buildings, wharves, freight, etc., belonging to the company, to the amount of $1,500,000. The fire started in a lard refinery on 59th street and spread so rapidly that the employés had to jump from the windows. Several men were injured and one killed. There were over 2,000 barrels of lard and oil in the building, so that the fierceness of the fire was beyond all control. The oil and the grain burned three days, in spite of the strenuous work of the firemen. The total loss from the fire was about $3,000,000. The New York Central's insurance was only $560,000, the company's policy generally being not to insure its property. Only one of the elevators will be replaced.

RAILROAD LAW—NOTES OF DECISIONS.

Powers, Liabilities and Regulation of Railroads.

The Supreme Court of Kansas holds that, under the provisions of the constitution of the state, a railroad company must make full compensation for the right of way appropriated to the corporation, irrespective of any benefits or supposed benefits from the construction of the road, or any improvement thereby.[1]

In Mississippi the Supreme Court decides that under the charter of the Y. & M. V. R. Co., which exempts the property of the company from taxation "for a term of twenty years from the completion of said railroad to the Mississippi River, but not to extend beyond 25 years from the date of the approval of this act," the exemption was intended to commence from the completion of the road to the Mississippi River, and not during its construction; and, the road not having been completed, is subject to a subsequent statute making all railroads liable to taxation, though at the date of the charter railroads were not liable to taxation during construction, under the general laws.[2]

In New York the Federal Circuit Court rules that Congress can lawfully confer upon a railroad corporation the capacity to occupy navigable waters within a state, and appropriate the soil under them, upon acquiring the rights of the owners, in order to construct a bridge over such waters for the purposes of interstate commerce, without the consent, and notwithstanding the protest, of the state.[3]

In West Virginia the Court of Appeals lays it down that as far as the public is concerned, when what railroad corporations need is for "public use," they have the right to invoke the exercise of eminent domain; but, in so far as that which concerns them as to their private interests, their profits and gains are concerned, they stand as individuals, or merely as private corporations, in which the public has no concern, and for such private purposes cannot call into exercise the power of eminent domain. Therefore, where a railroad corporation sought to condemn land, over which to build a switch, branch road, or lateral work, to reach a private manufactory, a steel-mill, for the purpose of transporting freight to and from said steel-mill over petitioner's road, it was held that the use to which the land was to be subjected was a private, not a "public, use."[4]

In California the Supreme Court decide that an ordinance requiring the Southern Pacific Railroad Co. to take out a license in order to continue its business in a county of carrying persons or freight for hire by means of railroad cars is void as a tax upon the use of a franchise granted by the United States.[5]

An act of Congress of March 3, 1871, incorporating the T. & P. R. Co., and granting land in aid of the construction of its road, authorized it, by section 4, to purchase the land grant and franchise of, and to consolidate with, any railroad company along its route. Section 5 authorized it to make traffic arrangements with other companies. Section 6 provided that the rights, franchises and property of every description, belonging to the consolidated or purchased companies, should vest in and become the property of the T. & P. Co. The Supreme Court of New Mexico holds that said company had no authority to transfer its own land grant and franchises to another company, and retain merely an easement over the right of way.[6]

Carriage of Goods and Injuries to Property.

In North Carolina the Supreme Court rules that in an action of trespass against a railroad company for invading plaintiff's garden and laying its tracks within 30 feet of the house, its charter prohibiting it from taking any dwelling-house, garden, etc., without the owner's consent, no recovery can be had for hazard to the house by the proximity of the tracks and the consequent danger from fire.[7]

In Kansas the Supreme Court decides that the rule prescribed by the Laws of 1885, that the occurrence of a fire caused by the operation of a railroad is *prima facie* evidence of negligence on the part of the railroad company, applies to all cases where the fire results from any step in the operation of the road, either of negligence in allowing combustible material to accumulate on the roadway or where fire was permitted to escape from a passing locomotive.[8]

In the same state the Supreme Court holds that where a railroad is laid through a farm or tract of land used for stock purposes, or adapted to stock purposes, the accidental danger to which stock thereon will be exposed may be considered in giving compensation to the land owner for the right of way appropriated for the railroad.[9]

The Iowa code provides that whatever is "an obstruction to the free use of property, so as essentially to interfere with the comfortable enjoyment of life or property, is a nuisance, and a civil action * * * may be brought thereon by any person injured thereby." The Supreme Court decides that one who has established on a navigable lake, after a railroad bridge had been built essentially interfering with navigation, the business of letting boats to pleasure parties, does not sustain such peculiar injury, from the bridge, in distinction from the general public, as to entitle him to bring an action under the statute, though his business is materially injured.[10]

In Iowa the Supreme Court holds that a railroad, although authorized by law to construct its road across a stream, is liable for damage done to lands adjacent thereto by the construction of a bridge, which causes the water and ice to gorge and overflow such land; and in the selection of the character of bridge to be built due regard must be had to the rights of the adjacent land owners, as well as the safety of the public who may travel over this road, or who may require the use of the same for the transportation of property.[11]

In the same state the Supreme Court rules that in a proceeding to assess damages for a right of way an owner cannot recover for detriment to his land outside of the right of way, caused by the railroad taking soil therefrom, this being a mere trespass, for which an action lies.[12]

Injuries to Passengers, Employes, and Strangers.

In Texas the Supreme Court rules that a railroad is liable for injuries to one crossing the track, occasioned by sending cars in swift motion, with no one at the brakes, upon a switch track where persons commonly pass, without objection from the company, though not a public crossing.[13]

In Minnesota the deceased was driving a heavily loaded wagon on a street in a large city, crossed at its intersection with another street by four tracks of defendant's road. A gate was usually lowered across the street, controlled by men in an observation tower, who, being unable to see by reason of the fog, were at the time acting as flagmen, the gate being raised. Several teams were in waiting for a passing freight train, and when the track was clear they attempted to cross, deceased being last. As his horses were on the rails an alarm was given of a passenger train approaching, and two men on the wagon with deceased jumped off safely. Deceased struck his horses to urge them forward, the wagon was dashed against the curb-stone, the foot-board upon which deceased's feet rested broke, he fell under the wagon wheels and was killed; the horses escaping. It was uncertain whether deceased attempted to jump, and springing from the foot-board broke it. There was evidence that it was defective, but none that deceased knew it; one of the other men who was heavier than deceased sprang off of it without its breaking. The Federal Court rules that there was no evidence of contributory negligence in the use of the defective foot-board.[14]

In Missouri the plaintiff got on the front of the defendant's switch engine, which was then switching cars, at the invitation of defendant's brakeman. It did not appear that the brakeman was acting within the scope of his employment. The engine was thrown from the track, and plaintiff was injured. The Supreme Court holds that the defendant is not liable.[15]

In Kansas the Supreme Court rules that the failure to sound the whistle of a locomotive approaching a crossing, as the statute requires, is not ordinarily negligence to a traveler who sees the train 80 rods away, and knows that it is approaching.[16]

In a Missouri case it appeared that defendant's freight train was drawn up on a side track in front of the depot, awaiting the arrival of a passenger train. There was a public crossing to the east of the depot, and a depot crossing west of it, both of which the freight train obstructed. Plaintiff, a child six years of age, on his way to the depot started to cross in front of the train near the depot crossing; but, the train beginning to move, he turned and walked toward the caboose, and, while so walking, from some cause stumbled, and fell under the moving cars. The Supreme Court rules that the blocking of the depot crossing, not being the immediate cause of the injury, the railroad company was not liable, even if it had been its duty to have it open at the time.[17]

1 Leroy & W. R. Co. v. Ross, 20 Pac. Rep., 197.
2 Y. & M. V. R. Co. v. Thomas, 5 South Rep., 108.
3 Penn. R. Co. v. B. & N. Y. R. Co., 37 Fed. Rep., 129.
4 Pitts. W. &. R Co. v. Benwood Iron Works, 8 S. E. Rep. 453.
5 San Benito Co. v. S. P. R. Co., 19 Pac. Rep., 827.
6 South Pac. R. Co. v. Esquibel, 20 Pac. Rep., 109.
7 Fore v. Western R. Co., 8 S. E. Rep., 335.
8 Mo. Pac. R. Co. v. Merrill, 19 Pac. Rep., 793.
9 Leroy & W. R. Co. v. Ross, 20 Pac. Rep., 197.
10 Innes v. Cedar R., I. F. & N. W. R. Co., 40 N. W. Rep., 701.
11 McCleneghan v. O. & R. V. R. Co., 41 N. W. Rep., 350.
12 Dodd v. M. C. & F. D. R. Co., 41 N. W. Rep., 65.
13 St. L., A. & T. R. Co. v. Crosnoe, 10 S. W. Rep., 342.
14 McIntosh v. C., M. & St. P. R. Co., 36 Fed. Rep., 661.
15 Shuyler v. Mo. Pac. R. Co., 9 S. W. Rep., 905.
16 A., T. & S. F. R. Co. v. Walz, 19 Pac. Rep., 787.
17 Barkley v. Mo. Pac. R. Co., 9 S. W. Rep., 793.

General Railroad News.

MEETINGS AND ANNOUNCEMENTS.

Dividends.

Dividends on the capital stocks of railroad companies have been declared as follows:

Baltimore & Ohio (*Washington Branch*), 5 per cent., payable May 1.
Cleveland, Lorain & Wheeling, 2 per cent.
Concord, 5 per cent., payable May 1.
Northern (*N. H.*), 3 per cent., payable May 1.

Meetings.

Meetings of the stockholders of railroad companies will be held as follows:

Atchison, Topeka & Santa Fe, annual meeting, Topeka, Kan., May 9.
Burlington, Cedar Rapids & Northern, annual meeting, Cedar Rapids, Iowa, May 28.
Chicago, Burlington & Quincy, annual meeting, Chicago, Ill., May 15.
Cincinnati, Indianapolis, St. Louis & Chicago, special meeting, Indianapolis, Ind., May 15, to consider the agreement for consolidation with the Cleveland, Columbus, Cincinati & Indianapolis, and the Indianapolis & St. Louis roads.
Cleveland, Columbus, Cincinnati & Indianapolis, special meeting, Cleveland, Ohio, May 15.
Hancock & Pennsylvania, special meeting, 16 Exchange Place, New York, May 18.
Lake Shore & Michigan Southern, annual meeting, Cleveland, O., May 1.
Louisville, Evansville & St. Louis, special meeting, Mt. Vernon, Ill., May 20.
Michigan Central, annual meeting, Detroit, Mich., May 2.
Missouri, Kansas & Texas, annual meeting, Parsons, Kan., May 15.
Pittsburgh, Fort Wayne & Chicago, annual meeting, Pittsburgh, Pa., May 15.

Railroad and Technical Conventions.

Meetings and conventions of railroad associations and technical societies will be held as follows:

The *American Railway Master Mechanics' Association* will hold its next annual convention at Niagara Falls, beginning Tuesday, June 18, with headquarters at the International Hotel. All who wish to secure rooms should apply to Mr. A. H. Gluck, Manager, International Hotel, Niagara Falls, N. Y.

The *Master Car-Builders' Association* will hold its next annual convention at Saratoga Springs, N. Y., June 25. Hotel accomodations may be secured by applying to H. S. Clement, Manager Congress Hall.

The *Train Dispatchers' Association* will hold its second annual convention in Indianapolis, Ind., June 12. E. J Peabody, 237 Franklin street, Chicago, is Secretary.

The Association of American Railway Accounting Officers will hold its next meeting at Niagara Falls, N. Y., in July.

The American Society of Mechanical Engineers will hold its next annual meeting at Erie, Pa., May 14, 15 and 16.

The International Association of Car Accountants will hold its fourteenth annual meeting at Plank's Grand Hotel, Island of Mackinaw, Mich., June 25.

The Traveling Passenger Agents' Association will hold its next meeting in Plank's Hotel, Mackinac Island, Mich., July 9.

The Roadmasters' Association of America will hold its seventh annual convention at Denver, Colo., Sept. 10.

The New England Roadmasters' Association will hold its next meeting in Boston, August 21.

The American Association of General Passenger and Ticket Agents will hold its next semi-annual meeting in Atlanta, Ga., Sept. 17.

The National Association of General Baggage Agents will hold its next meeting at Detroit, Mich., July 17.

The *National Association of Railway Surgeons* holds its annual convention in St Louis, Mo., May 2, 1889.

The *New England Railroad Club* meets at its rooms in the Boston & Albany passenger station, Boston, on the second Wednesday of each month.

The *Western Railway Club* holds regular meetings on the third Tuesday in each month, except June, July and August, at its rooms in the Phenix Building, Jackson street, Chicago, at 2 p. m.

The *New York Railroad Club* meets at its rooms, 113 Liberty street, New York City, at 7:30 p. m., on the third Thursday in each month.

The *Central Railway Club* meets at the Tifft House, Buffalo, the fourth Wednesday of January, March, May, August and October.

The *American Society of Civil Engineers* holds its regular meetings on the first and third Wednesday in each month at the House of the Society, 127 East Twenty-third street New York.

The *Boston Society of Civil Engineers* holds its regular meetings at its rooms in the Boston & Albany sta-

tion, Boston, at 7:30 p. m. on the third Wednesday in each month.

The *Western Society of Engineers* holds its regular meetings at its hall, No. 67 Washington street, Chicago, at 7:30 p. m., on the first Tuesday in each month.

The *Engineers' Club of St. Louis* holds regular meetings in St. Louis on the first and third Wednesdays in each month.

The *Engineers' Club of Philadelphia* holds regular meetings at the house of the Club, 1,122 Gerard street, Philadelphia.

The *Engineers' Society of Western Pennsylvania* holds regular meetings on the third Tuesday in each month, at 7.30 p. m. at its rooms in the Penn Building, Pittsburgh, Pa.

The *Engineers' Club of Kansas City* meets at Kansas City, Mo., on the first Monday in each month.

The *Civil Engineers' Society of St. Paul* meets at St. Paul, Minn., on the first Monday in each month.

The *Montana Society of Civil Engineers* meets at Helena, Mont., at 7.30 p m. on the third Saturday in each month.

The *Civil Engineers' Club of Kansas* holds regular meetings on the first Wednesday in each month at Wichita, Kan.

American Society of Mechanical Engineers.

A meeting is to be held at Erie, Pa., May 14 to 17. A local committee of arrangements has made up a programme of visits to various points of interest. Among the professional papers to be presented are the following:

Thos. S. Crane, The Piping of Steel Ingots; Henry R. Towne, Gain Sharing; Chas. H. Manning, Comparative Cost of Steam and Water; D. W. Robb, The Old Locomotive, "Samson;" Jas. E. Denton, D. S. Jacobus, Steam Consumption by Engines of Various Speeds; De Volson Wood, Expansion of Timber due to Absorption of Water, and Some Properties of Vapor and Vapor Engines; F. W. Dean, Distribution of Steam in the Strong Locomotive (Supplement); Jay M. Whitham, Cylinder Ratios in Triple Expansion Engines.

Boston Society of Civil Engineers.

A regular meeting was held April 17. Messrs. William C. Boyce, Edmund Grover, Francis E. Hosmer and Frank B. Rowell were elected members of the society. Messrs. C. H. Swan, T. W. Davis and A. W. Hunking were appointed a Committee on weights and measures. The Secretary read a memoir of George A. Parker, honorary member, prepared by the late Samuel A. Felton, also an honorary member. Mr. Albert H. Howland read a memoir of Edward S. Philbrick. Mr. Lawson B. Bodwell read a paper describing the relocation of a portion of the New York & New England Railroad, made necessary by the construction of the Sodom reservoir of the new Croton supply. He also gave an interesting account of an embankment built through Whaley Pond. Mr. Samuel M. Graves, City Engineer, Providence, R. I., read a paper and gave a history of the various schemes proposed for railroad terminal facilities in Providence. On motion of Mr. Howe a vote of thanks was extended to Mr. Graves.

The Secretary was directed to keep a record of addresses of members and others seeking employment, giving positions desired, address of last employer and such other information as may seem desirable.

Civil Engineers' Club of Cleveland.

A regular meeting was held April 9, Mr. W. H. Searles in the chair and 17 members present. Mr. Searles stated that he wished instruction as to a proposed change in the constitution of the Association of Engineering Societies. The question is on the amendment of the constitution in such a way as to extend the relations of the various societies which belong to the association into other matters than the publication of the *Journal*.

Prof. Cady Staley made an address on some experiments with flushing tanks, which was very fully discussed.

Engineers' Club of St. Louis.

A meeting was held April 17, 21 members and 2 visitors being present, Mr. Holman in the chair. The Chairman announced the death of Col. Henry H. Moore, one of the oldest members and a former president. A paper by Prof. Charles C. Brown on the sanitary condition of the water supply of New York City was read by Prof. Wheeler. The secretary then read a paper by Mr. A. J. Firth, describing a system of marking patterns. The question was treated in detail and the essential points explained. Mr. Firth also submitted a brief discussion on economy in manufacture as affected by patterns.

International Association of Car Accountants.

The Executive Committee issue the following announcement:

The fourteenth annual meeting of this Association will be held at Plank's Grand Hotel, Island of Mackinaw, Mich., Tuesday, June 25, 1889 (instead of June 18).

The hotel is new, with accommodations for 1,600 guests; rates will be low. The island is nature's beauty spot, where rest and pleasure combine, and where we can do thoughtful business without the thousand and one interruptions, attractions and surroundings of great cities. All members are urgently requested and invited to attend.

Roadmasters' Association of America.

Friday, April 19, the Executive Committee of the Roadmasters' Association of America held a special meeting in New York to decide on the subjects to be brought up before the coming convention to be held at Denver in September. The convention is to last three days, and have two sessions a day. The subjects for each session, respectively, are as follows: 1. Rail joints; 2. Labor on track; 3. Frogs and switches. Protection of facing point switches and signals; 4. Track tools; 5. Cattle guards; 6. Gates for crossings and crossing protection.

The committee also made a short tour of inspection of the Manhattan Elevated, and visited the Ramapo Iron Works. Only two new committees on the above subjects were appointed, four of the former committees being retained.

Western Society of Engineers.

A regular meeting of this society was held April 19, President Corthell in the chair. There were about 50 members present. Mr. John Sylvester Glenn was elected a member of the society. A report was received from the committee to examine into the financial condition of the society, with reference to increase of dues. The present plans of the society and the ordinary expenditures will involve a deficit, with the present revenue, of about $400, and it is necessary for the society to consider what will be done. The committee suggests that one means of economy is a reduction in the expense of printing the "Proceedings" and papers of the society. The annual dues of resident members were raised to $10. Messrs. Moorehouse, Gottlieb, Williams and Weston were appointed a committee to consider changes in the constitution and by-laws necessary to the creation of a board of directors, who could perform much of the routine business of the society and leave the regular monthly meetings free for professional matters. The society passed a resolution congratulating Mr. Cregier, a member of the society and Past President, upon his election as Mayor of Chicago.

PERSONAL.

—Col. Charles C. Smith, formerly Chief Engineer of the St. Paul, Minneapolis & Manitoba, died of apoplexy, April 17, while visiting friends at Norwalk, O.

—Mr. J. H. Setchel, President of the American Railway Master Mechanics' Association, has resigned his position with the Martin Car Heater Co., to become Traveling Agent of the Pittsburgh Locomotive & Car Works. These works are enlarging their capacity.

—Mr. Johnson N. Camden, Jr., Treasurer of the Ohio Valley road, has resigned that position to accept a similar one with the Parksburg Construction Co., which will build the Monongahela River and other railroads in West Virginia. Mr. Camden has been succeeded on the Ohio Valley by the former Auditor, N. M. Trevor.

—Mr. George D. Wadley has been appointed General Manager of the Kentucky Union. Mr. Wadley was formerly Engineer of Construction of the Mexican Central road, which position he resigned to become Superintendent of the Owensboro & Nashville division of the Louisville & Nashville. J. F. Babbitt, of Louisville, Ky., has been appointed Auditor of the road.

—Mr. Max E. Schmidt, Chief Engineer of the Tampico Division of the Mexican Central, has resigned on account of ill health, his resignation to take effect May 15. Mr. Schmidt is the engineer who located and constructed the line through the famous Cañon de Tamasopo, which is now completed. To give an idea of the difficulties that were met by the engineers in locating the line through this cañon, it need only be stated that the ground was so rough and dangerous that the locating party found it impracticable, if not impossible, to return to their regular camp at night, and that the members of that party slept in hammocks suspended from the rocks at the end of the line each night as long as the locating work lasted. Mr. Schmidt sails for Europe on May 29 with the American Society of Civil Engineers.

ELECTIONS AND APPOINTMENTS.

Alabama Timber, Coal, Iron & Railway Co.—The officers are: Hinton C. Carr, of the Walker County Bank, of Jasper, President: Hon. Jacob G. Chamberlain, Receiver of the Sheffield & Birmingham Coal, Iron & Railroad Co., Vice-President; Hon. John B. Shields, Secretary, and John B. Long, Treasurer.

Chicago, Milwaukee, & St. Paul.—William Kelly, Jr., has been appointed Traveling Passenger Agent, with headquarters at Columbus, O., vice John O'Laughlin, resigned.

Chicago & West Michigan.—At the annual meeting of the stockholders of the road, held in Muskegon, Mich., April 17, the following directors were elected: H. H. Hunnewell, C. F. Adams, Charles Merriam, James H. Blake, C. O. Shuttock, N. Thayer, E. V. R. Thayer, A. H. Hardy, of Boston, and J. B. Mulliken, of Detroit.

Centralia & Chester.—The incorporators and first board of directors are: Lewis F. Casey, G. P. Duncan, A. X. Dunker, Jacob Grosch and B. Haussler, all of Centralia, Ill. The principal office will be at Centralia.

Central Ohio.—The annual meeting of the stockholders of the road was held in Columbus, Ohio, April 24, and the following board of directors was elected: James H. Collins, Walter B. Brooks, Joseph W. Jenkins, Joshua G. Harvey, Osman Latrobe, A. B. Crane, John R. Hall, John Hoge, C. H. Kiblock, Daniel C. List, David Lee, Gilbert G. Hoover, W. W. Peabody, J. H. Collins, of Columbus, was re-elected President, and W. B. Ijams, of Baltimore, Secretary and Treasurer.

Chicago, St. Paul & Kansas City.—S. E. Stohr, General Agent of the Texas & Pacific in New York, has been appointed General Eastern Agent of this road in place of P. C. Stohr, who has become General Freight Agent at Chicago.

Cincinnati, Hamilton & Dayton.—J. B. Porter has been appointed Engineer of Maintenance of Way, with office in Cincinnati, O.

Cleveland, Columbus, Cincinnati & Indianapolis.—D. C. Kelsey, Assistant General Passenger Agent of the Ohio, Indiana & Western, has been appointed Chief Clerk of the passenger department, succeeding C. A. Cairns, who resigned to accept a similar position with the Chicago, St. Paul & Kansas City at Chicago.

Delaware & New England.—The incorporators of this Delaware company are: John S. Wilson, Charlemagne Tower, Jr., Arthur E. Newbold, Henry McCormick, Francis W. Kenney, Stephen A. Caldwell, John W. Brock, W. W. Gibbs, Arthur Brock, Henry O. Seizas, Joseph F. Sinnot, Charles F. Berwind and Chas. E. Morgan, Jr.

Duluth, Red Wing & Southern.—J. H. Lakey formerly Division Superintendent of the Chicago, Milwaukee & St. Paul, has been appointed General Superintendent of this road.

Eutawville.—At the annual meeting, in Charleston, S. C., the following directors were elected: R. C. Barkley, Gen. John Harlin, W. H. McKenna, S. J. Pregnall, A. Ames Howlett, O. M. Chace and L. Loesberger. At a meeting of the directors R. C. Barkley was elected President, John Harlin Vice-President, and O. M. Chace Secretary and Treasurer.

Evansville, Suburban & Newburgh.—At a meeting held at Evansville, Ind., April 19, the following officers and directors were chosen: President, Lee Howell; Vice-President, W. J. Wood; Treasurer, S. P. Gillett; Secretary, H. Cornack. Directors, Wm. Heilman, D. J. Mackey, F. W. Cook, W. J. Wood, Lee Howell, J. B. Cox, of Evansville, and Chas. Hopkins, of Newburgh, Ind.

Fort Worth & Albuquerque.—At a meeting of the stockholders of the Fort Worth & Albuquerque Construction Co. held in Fort Worth last week, E. W. Taylor, W. M. Harrison, W. F. Sommerville, W. F. Lake, M. C. Hurley, R. H. Sellers and W. S. Pendleton were elected directors. W. F. Sommerville was elected President and M. C. Hurley Vice-President.

Kansas City & Pacific.—M. C. Lapinn has been appointed Acting Auditor, with office at Parsons, Kan., vice F. C. Federer, deceased.

Kentucky Union.—George D. Wadley has been appointed General Manager of the company, with office in Louisville, Ky.

Lehigh Valley.—H. B. Abbott has been appointed Superintendent of Docks at Buffalo, N. Y., and will have charge of the transfer of traffic from and to cars and warehouses or boat.

Los Angeles & Hueneme.—D. McFarland, John M. C. Marble and W. G. Hughes, of Los Angeles; Thomas R. Bard and Alfred J. Salisbury, of Hueneme, are the California company.

Louisville, New Albany & Chicago.—W. H. Newman has been appointed General Southern Agent at Atlanta, Ga., and A. B. Wrenn has been made Traveling Passenger Agent for the same territory.

Neversink Valley.—The directors of this New York Company are: John H. Drake, William D. Stratton, William B. Royce, John W. Low, Thomas Watts, Charles Clark, Charles H. Mapes, Middleton, N. Y.; W. H. H. Williams, Michael Denman, Neversink Flats, N. Y.; J. C. Anderson, Englewood, N. J.; F. S. Ketcham, R. T. Low, R. S. Sayer, New York.

Ocean View.—This company, which has built a short road near Wilmington, N. C., has chosen Stacy Van Amringe President, and S. H. Manning, Secretary and Treasurer. The offices are at Wilmington, N. C.

Ohio River.—J. N. Camden, Jr., having resigned as Treasurer of this company, W. M. Trevor has been appointed Treasurer, with office at Parkersburg, W. Va.

Oregon Railway & Navigation Co.—C. J. Smith has been appointed General Manager, vice W. H. Holcomb, resigned, with headquarters at Portland, Or.

Owensboro & Nashville.—L. S. Robertson has been appointed Superintendent, vice George D. Wadley, resigned.

Pekin & Bartonville.—The first board of directors is: Thomas Cooper, A. B. Sawyer, H. H. Cole, A. G. Walker, E. W. Wilson, George Gregg, and I. N. Munson, all of Pekin.

St. Augustine & North Beach.—The following are the officers of this new Florida company: Virgil Powers, of Macon, Ga., President; E. B. Waters, of Butler, Ga., Vice-President, and C. W. Hendrick, Secretary.

St. Louis, Alton & Springfield.—L. C. Haynes, Secretary, has been appointed Treasurer, with office in St. Louis, to permit H. A. Fisher, who has heretofore been Treasurer, to devote his whole attention to the duties of the position of General Manager.

Sandusky, Lake Erie & Southern Short Line.—The directors of this new Ohio company are John McKelvie, Henry C. Huntington, David Kuntz and Edmund Zurhoist, of Ohio, and John Jay McKelvie, of New York.

Sheffield & Birmingham.—At the annual meeting of the stockholders held at Sheffield, Ala., April 19, the following officers and directors were elected: A. H. Moses, President; W. L. Chambers, Vice-President and General Manager; J. F. Burke, Secretary; J. V. Allen, Treasurer. Directors, J. C. Neely, J. W. Burke, C. D. Woodson, W. L. Chambers, Enoch Ensley, C. M. McGhee, Samuel Thomas, Alfred Parrish, A. L. Colyer, S. A. Champion, J. Hill Erkin, E. W. Cole, J. W. Thompson.

Southern Kansas & Texas.—The stockholders met in Fort Worth, April 18, and elected George Sealy, T. W. Jackson and J. H. Scott, of Galveston; H. M. Van Zandt and E. W. Taylor, of Fort Worth; W. B. Strong, J. T. Burr, S. W. Nickerson and Alden Speare, of Boston, directors. W. B. Strong was chosen President; C. W. Smith, Vice-President; A. A. Robinson, Second Vice-President, Manager and Chief Engineer; J. F. Goddard, Third Vice-President; E. Wilder, Secretary and Treasurer; George R. Peck, General Solicitor; J. W. Reinhart, General Accountant; J. P. Whitehead, Comptroller; H. C. Clements, Auditor.

Tennessee Coal, Iron & Railroad Co.—D. S. Lamont and ex-Senator Thomas C. Platt, of New York, have been elected directors of the company.

Union Pacific.—At the annual meeting in Boston April 24, the old board of directors was re-elected as follows: Charles F. Adams, Frederick L. Ames, Edwin F. Atkins, Samuel Carr, Jr.; F. Gordon Dexter, John P. Spaulding, of Boston; Henry H. Cook, Sidney Dillon, David Dows, and A. H. Green, of New York; Grenville M. Dodge, of Council Bluffs; William H. Holcomb, and J. H. Millard, of Omaha; John Sharp, of Salt Lake City, and James A. Rumrill, of Springfield. Mr. Adams was chosen President, W. H. Holcomb, Vice-President; Gardiner M. Lane, Boston, Second Vice-President; Oliver W. Mink, Boston, Controller; Alexander Millar, Boston, Secretary, and James M. Ham, New York, Assistant Secretary.

Valley (Ohio).—At the annual meeting, held in Cleveland, O., recently, the directors whose terms expired were W. J. Boardman, L. M. Coe and John Tod. To succeed them, the following were elected: W. S. Jones and Andrew Squire, of Cleveland, and J. H. Wade, Jr., of New York. The directors elected the old officers: President, J. H. Wade; Vice-President, D. L. King, of Akron; Treasurer, S. T. Everett; Secretary, W. B. Porter, and General Manager, William Thornburg.

Wheeling, Wellsburg & State Line.—At a special meeting of the stockholders, held in Wellsburg, W. Va., April 20, the following were elected directors: Samuel George and D. Brown, of Wellsburg; J. A. Miller, C. B. Hart and J. S. Naylor, of Wheeling; Joseph Ramsey, Jr., Cincinnati, and A. B. Paul, of Hopedale, O. Samuel George was chosen President, D. Brown Treasurer and A. B. Paul Secretary.

OLD AND NEW ROADS.

New Companies Organized.—Birmingham, Sheffield & Tennessee River.—Oveido, Lake Charm & Lake Jesup.—Pekin & Bartonville.—St. Augustine & North Beach.—Sandusky, Lake Erie & Southern Short Line.—Sparta & Ste. Genevieve.

Alabama Midland.—The $90,000 asked by the Alabama Terminal & Improvement Co. to secure an extension of this road to Tuskaloosa has all been raised, and it is probable that work will soon be commenced.

Alabama Timber, Coal, Iron & Railway Co.—Organized at Jasper, Ala., to develop coal and timber lands in Alabama and to build a standard gauge road from Jasper northeast to the coal fields near that town. A survey is now in progress from Jasper which will be continued to Decatur, about 55 miles from Jasper.

Atlantic & Danville.—The company has made a proposition to the Danville (Va.) City Council to extend its line from Danville to the mineral fields of Southwest Virginia in two years, provided the city will subscribe $900,000 to the company's stock.

Birmingham & Atlantic Air Line.—About half of the right of way for this road between Birmingham, Ala., and Macon, Ga., about 175 miles, is said to have been secured, and it is claimed that contracts will be let probably in May. The route is through Talladega and Rosnoke, Ala., and Thomaston, Ga., and about 40 miles is graded. Col. W. E. H. Searcy, of Griffin, Ga., is President and H. S. Watt is Chief Engineer.

Birmingham, Sheffield & Tennessee River.—The Sheffield & Birmingham Coal, Iron & Railway Co. last week sold its railroad, extending from Sheffield to Jasper, Ala., 87 miles, to Alfred Parrish, of Philadelphia, and it will hereafter be known under the above name. The road is in

operation under a Receiver, from Sheffield, on the Tennessee River, southerly to Jasper, on the Kansas City, Memphis & Birmingham.

Boston Elevated.—The Committee of the Massachusetts Legislature on Street Railways has agreed to report in the House a bill in favor of the petition of Frank M. Ames, John Shepard, D. F. Lamson and others to construct an elevated railroad in the city of Boston. The capital will be $750,000 for each mile constructed.

Brazoria & Northern.—Incorporated in Texas to build a road from the mouth of the Brazos River to Houston, Tex., with several branches. W. M. D. Lee, of Leavenworth, Kan., is President.

Centralia & Altamont.—This company has filed a charter in Illinois to build a road from the eastern terminus of the Centralia & Chester Railroad at Centralia to Altamont. The capital stock is $100,000, and the chief office will be in Centralia.

Chihuahua, Sonora & Sinaloa.—Grading on the first 25 miles of this road from Guaymas south will be completed in a few weeks. The work is comparatively light. The soil is sandy and the country is practically level. The distance from Guaymas, the northern terminus, to Topolobampo Bay, the southern terminus, is 225 miles. The line has been surveyed, but engineers are still in the field. Richards, Clegg & Co., who have the contract for completing the road, now want rail fastenings, switch stands, etc. Their address is Guaymas, Sonora, Mex.

Cincinnati, Alabama & Atlantic.—Two surveying parties are now in the field, one locating from Fayetteville to Tullahoma, Tenn., and the other working from the former place to Huntsville, Ala.

Columbia, Newberry & Laurens.—On April 19 contracts were closed with the Congaree Construction Co. for the completion and equipment of this road by May 1, 1890. Work will probably commence at once, and be pushed as rapidly as possible. H. C. Mosely is President of the Railroad Co., and W. H. Lyles of the Construction Co.; Charles Ellis, Jr., of Columbia, S. C., is Chief Engineer, and Charles C. Wilson is Principal Assistant Engineer.

Coshocton & Southern.—Tracklaying on this road, an extension of the Cleveland & Canton, from Coshocton to Zanesville, Ohio, has been finished to within 12 miles of the latter city. The company was served with injunctions to prevent it laying tracks through the town of Dresden, but, after a few days' delay, the matter was amicably settled.

Covington & Macon.—A survey has been commenced for a proposed branch from Machen, west, about 25 miles, to Jackson and thence to Griffin, 15 miles, further. This is an alternative route to the one by way of McDonough. As yet, no definite arrangements for the building of either line have been made.

Delaware & New England.—The bill to incorporate this company in Delaware has passed both houes of the Legislature. As already stated, the consolidation is to include the lines leading east and west from the Poughkeepsie bridge. The capital stock is placed at $800,000, and liberal powers concerning consolidation, etc., are granted.

Denver & Rio Grande.—The extension from Glenwood Springs to Rifle Creek, Col., 26 miles, has been completed to New Castle, about 12 miles, paralleling the Colorado Midland between these points. It is not thought that the Denver & Rio Grande will complete the road beyond this point, but that the Denver & Rio Grande Western and the Colorado Midland will form a company in which they will be joinely interested to build a road from New Castle to Grand Junction.

Elizabeth & Hodgenville.—Thomas H. Hays, of Louisville, Ky., is reported to have been awarded the contract for a five mile extension of this road, which is now operated by the Newport News & Mississippi Valley Co.

Flint & Pere Marquette.—The company is recording in Michigan a consolidated mortgage on all its lines in favor of the Central Trust Co. of New York, to secure an issue of 50-year five per cent. bonds, to the amount of $10,000,000. With the funds secured the present indebtedness will be paid off, and the proposed branch to Detroit probably built.

Hartford & Connecticut Western.—Two routes have been under consideration for the proposed extension to Springfield. The directors have now adopted the line starting from the main road within half a mile of the Tariffville station, and running northeasterly through Kineyard Gap, through the West Suffield Valley, and west of Hastings Hill to the State line. The route in detail from the Connecticut line to Springfield has not been fully settled. It will, however, run through Agawan and West Springfield, crossing the Connecticut River north of the Boston & Albany road. Work will be begun on the extension this spring.

Hawesville & Pellville.—The stockholders last week decided to increase their capital stock from $150,000 to $1,102,000, and to extend the line to Hartford, in Ohio County, Ky., from Pellville, Daviess County, its present projected terminus. Surveys have been completed from Hawesville to Pellville, and the grading will soon begin.

Housatonic.—The Railroad Committee of the Connecticut Legislature on April 18 presented a majority report, signed by five of the nine committeemen, adverse to the petition of the Housatonic road for permission to build branches which would in effect make a road parallel to the New York, New Haven & Hartford, from New Haven to the New York line. The majority report recites that the Housatonic is not debarred by charter limitations from the operations of the general railroad law, but recommends a bill which will remove all doubt as to this question. It adds: "The petitioners ask also for the privilege of purchasing the property, franchises and stock of the New York & Connecticut Air Line road. To authorize the Housatonic to purchase this stock would be a radical departure in policy from the existing general railroad law of the state. The general railroad law was designed to facilitate the construction of railroads, and not the sale of charters. To make such a sale feasible, or to legalize one already contracted for, would be vicious legislation. The line of the New York & Connecticut Air Line runs parallel to the existing New York, New Haven & Hartford from New Haven to New York at an average distance therefrom of less than one mile. The Housatonic in effect asks for the privilege of building a new railroad from Bridgeport to Norwalk. It was admitted that it is the intention to build a parallel road on substantially the surveyed route of the New York & Connecticut Air Line to the New York state line, there to meet another road in Westchester County and to enter the city of New York. To grant the desired authority is undesirable. The road would in no proper sense of the word be a branch of the Housatonic. No branches should be constructed by any company unless they are required by public convenience and necessity. If they are constructed for any other purposes, a waste of capital would follow for which the general public would in the end suffer. Your committee believe that in the future the Board of Railroad Commissioners should first be required to adjudge that the construction of any branch of any railroad is required by public convenience and necessity." The committee recommends a bill to this effect. The report continues: "It is admitted that in frequency of trains, safety of travel and cheapness of transportation the Consolidated Railroad is second to no road in the country, which is a matter of just pride to the citizens of our state. There can never be any serious danger of a railroad monopoly, in the offensive sense of the term, by a road which is constructed immediately parallel to the waters of Long Island Sound, and with the facilities for building under the present railroad law." The minority report submits a bill granting the petition of the Housatonic road, but without argument.

Concerning the alleged over issue of stock and bonds, the committee makes a separate report as follows: It gives a history of the original charter of the company, the amendment of 1870, the general law of 1878 in relation to stock increase, and the general law of 1882 in relation to bonds. It finds that the preferred stock was issued under a contract made in 1845, under which 8 per cent. dividends should be declared out of net earnings, if any, before any dividend could be paid on the common stock. It finds that between 1870 and October, 1887, 17 years, no action was taken by the Housatonic Railroad Committee under the amendment of 1870, and that in 1887 men in New York purchased a large majority of both stocks, and thus obtained complete control of the corporation; that in October, 1887, the stockholders agreed to pay to each holder of preferred stock $100 in cash and to give him two shares of so-called new preferred stock of $100 each. The cash required to effect this settlement was raised by a sale of bonds to the amount of $1,180,000. It finds exchanges of stock for new preferred so as to make a stock increase of $1,150,400 and a bond increase of $1,960,000; that the Housatonic claimed upon the bearing that the amendment of 1870 was not repealed by the act of 1878 or 1882. It finds that a large part of the $903,000 item of increase in construction represented money expended upon leased roads in Massachusetts, which were in no sense a part of the cost of construction of the Housatonic, and which the Superior Court of the state had decided in the tax cases were not a part of the property of the Housatonic. A true statement of the construction account, Sept 30, 1888, would be $2,326,448; one-half of that would be $1,163,224; the total amount of bonds outstanding Sept. 30 was $3,080,000, and therefore the amount of bonds outstanding in excess of one-half the cost of construction was about $1,800,000. The report states that it was claimed by the Housatonic, that it had the right, under the amendment of 1870, to issue bonds without regard to the amount expended in construction. The committee finds that the Housatonic in 1888 had guaranteed the bonds of the New England Terminal Co. to the amount of $800,000, and that it was not claimed that these bonds were issued under authority of the act of 1870 in settlement of accumulated dividends. The officers of the company testified that the construction account had been entered in this manner after the new bonds and stock had been issued, in order to make the construction and equipment accounts agree with the stock and bond issues, or to make the accounts balance. The report says in conclusion: "Your committee can but express decidedly their condemnation of the manner in which the accounts of the Housatonic have been written up. As to the issues of stocks and bonds they deem it their duty to report fully the facts regarding the same rather than their conclusions of law. Many of these bonds have been passed into the hands of bona fide purchasers. The questions involved are legal in their character, rather than legislative, and will undoubtedly ultimately be decided in our courts."

Knoxville, Cumberland Gap & Louisville.—The tracklaying has been completed for over 40 miles from Knoxville, Tenn., north to the Cumberland Gap Tunnel. All the grading is done and the entire line will be completed early in July. On the Knoxville Southern, south from Knoxville, about 40 miles has been graded. The line is by way of the Hiawassee River and Ducktown, Tenn., to a connection with the Marietta & North Georgia, probably near Blue Ridge. Tracklaying is in progress on the line. When these two roads and the extensions of the Marietta & North Georgia are completed, they will form a continuous line from Atlanta to the Cumberland Gap Tunnel, where connections will be made with the Norfolk & Western and the Louisville & Nashville, both of these roads, as has already been stated, being engaged in building extensions to that point. The Cumberland Gap Tunnel, which is 3,750 ft. long, will probably be completed by August next. The roads and tunnel are being built by the American Association, Limited, of London, England.

Kokomo Belt.—This company is building a belt road at Kokomo, Ind., but the Lake Erie & Western has prevented it from crossing its track in the town by chaining an engine to the track at the proposed crossing. As the story goes, on April 17, when the engine was run off to allow a through freight to pass, and before it could return, the Sheriff took possession of the crossing, and frogs were soon put in and an injunction against further obstruction served against the Lake Erie & Western.

Lake Temiscamingue.—Tracklaying is in progress on the section of this road between Gordon Creek and Kippewa Lake, Ont., nine miles. The section from Long Sault Rapids to Gordon Creek, six miles, is now in operation. Surveys will be made this summer to Mattawa, Ont., about 35 miles from Kippewa Lake, giving a line about 50 miles long from Long Sault Rapids to Kippewa Lake. Emmanuel Tasso is Superintendent.

Lampasas, Burnet & Southwestern.—The survey for this new Texas line is in progress under H. L. Higdon. It is to be built from Lampasas, on the Gulf, Colorado & Santa Fe, southwest to Burnet, on the Austin & Northwestern.

Louisville, Evansville & St. Louis.—At a meeting of the stockholders, to be held May 18, the proposed consolidation of the Huntingburg, Tell City & Connelton and the Belleville, Centralia & Eastern will be voted. As the control of all the roads is held by the same interest, the meeting will be merely formal.

Lynchburg & Durham.—It is now expected that the entire line from Lynchburg, Va., south to Durham, N. C., about 115 miles, will be completed by Nov. 1 next. The 10 miles from Lynchburg, south to Rustburg, have been in operation some time, and five more, to Winfall, has now been completed. Codwise & Allen, of Lynchburg, have the contract for grading and tracklaying to Lynchburg. No date has yet been decided when contracts will be let for the extension south from Durham to Merry Oaks, N. C., 26 miles.

Marietta & North Georgia.—On the extension north, to connect with the Knoxville Southern, about 6 miles of road has been completed this year, and work is in progress on 22 more, north through Ducktown, Tenn. The following are the contractors on this section, each having about 5 miles: S. P. Condon, R. Jones, Thomas McFarland and Charles Livingstone, all of Knoxville, Tenn. There will be no large bridges on the line.

Meridian Belt.—This company has been organized at Meridian, Miss., to build a standard gauge belt line around the city. C. W. Robinson and J. M. Richardson, of Meridian, are interested. The Chief Engineer is J. M. T. Hamilton, and his address is Meridian.

Mexican Central.—Bids are now being received for grading on the Tampico division from Cardenas to San Luis Potosi, Mex., about 116 miles, and it is expected to have the entire division from Tampico to San Luis Potosi open to traffic this year. All surveys have been made, and the entire line is located through to San Luis Potosi. The grading is now finished on this division west to the 145th mile, which includes the Tamasopo Cañon. The next 16 miles, which brings the line to Cardenas, will be completed by July 15. All the heavy work on the division will then be completed. Tracklaying will be finished this summer through the Mountain division.

Montgomery & Sylacauga.—About 21 miles of the preliminary survey for this road is finished, but as yet no steps have been taken to begin the location. The road is projected to extend from Sylacauga to Montgomery, about 65 miles, and the company has received several valuable privileges from the state. For about 15 miles an old stage road can be made use of, at an expense of about $1,000 per mile. Col. B. Dunham, of Montgomery, is General Manager, and H. G. McCall, of Calera, is Secretary.

Nashville & Knoxville.—This road has now been opened for traffic from Gordonsville east to Buffalo Valley, Tenn., and it is expected to have the line to Cookeville, opened by Oct. 1. East of Cookeville, two routes have been surveyed, but it has not yet been decided which to adopt. One route is from Cookeville, northeast to the coal regions of Overton and Fentress counties, and the other is east from Cookeville to Wartburg, with a branch line from Standing Stone into the coal region to the northward.

Neversink Valley.—Articles of incorporation have been filed in New York, with a capital stock of $120,000, to construct a railroad commencing at Fallsburgh Station on the New York, Ontario & Western, and running thence northerly to a terminus at or near Neversink Flats, a distance of about 10 miles.

New Roads.—The survey will be completed in about three weeks for a standard gauge road from Chattanooga, Tenn., to the top of Walden's Ridge at Signal Point. The distance is about 13 miles. It will cross the Tennessee River and continue along the foot-hills for about five miles, then ascend the ridge to Middle Creek, and proceed up the creek to the summit of the ridge. It is intended to be continued as a main line from the head of Middle Creek along the ridge, with branches to the undeveloped coal fields. Isaac C. Brewer, of Chattanooga, is Chief Engineer.

Engineers are reported surveying a railroad from St. Peters, the terminus of the French Creek Branch of the Wilmington & Northern road, to Phœnixville, Pa.

The Jellico Bird Eye Coal Co., at Jellico, Ky., is having surveys made for a standard gauge coal road, 6½ miles in length, to be built at once from the mines to a connection with the Louisville & Nashville.

Norfolk & Western.—George T. Mills, of Pulaski, Va., has the contract for building a branch from the end of the Periwinkle branch to the Tipton ore properties. On the Clinch Valley division track is now laid to Pounding Mill Station, and work is in progress on the remaining 74 miles to Norton. W. T. Patterson, of Pittsburgh, has been awarded the contracts for building the trestles and Howe truss bridges on the Clinch Valley division between the 66th and 92d miles. As already stated, Cofrode & Evans, of Pottstown, Pa., are erecting the trestles and bridges on the first 66 miles of this division.

Northern Pacific.—It is stated that by next November the company will have ready for traffic a new line through Homestake Pass to Butte, Mont.

North Louisiana & Arkansas.—A company of this name has been organized at Bastrop, La., to build a road from that place through Oak Ridge to Girard, in Richland Parish, a distance of about 20 miles.

Oveida, Lake Charm & Lake Jesup.—This company has been chartered in Florida to construct a railroad, 3½ miles long, in Orange County, from Lake Jesup to Lake Charm.

Pacific Short Line.—E. P. Reynolds, of Wymore, Neb., is reported to have secured the contract to build the Nebraska & Western for 100 miles west of Sioux City, Ia., for which bids were recently asked. Over 100 proposals were received.

Pekin & Bartonville.—Charter filed in Illinois to build a road from Pekin, Tazewell County, Ill., to Bartonville, Peoria County, and thence to the city of Peoria, the principal office to be at Pekin. The capital stock is $100,000.

Pennsylvania.—The company will soon expend $200,000 in improvements on the river front, at Philadelphia. The market property and wharves at Vine street, purchased recently for $545,000, are to have expended on their improvement $125,000. The road will set back the abutments of the main line bridge over the Philadelphia & Reading at a heavy cost.

Pittsburgh & Lake Erie.—A mortgage for $4,000,000 issued by the road to the New York Trust Co. has been filed at Youngstown, O., for record.

Richmond, Nicholasville, Irvine & Beattyville.—Grading has begun at Irvine, Estell County, Ky., on the section between that town and Richmond.

St. Augustine & North Beach.—Incorporated in Florida, with a capital stock of $150,000, to build a railroad from St. Augustine to the Atlantic coast.

Shenandoah Valley.—It is stated that very soon after the receipt by the Reorganizing Committee of a certified copy of the opinion of the Virginia Court of Appeals defining the liens of the first and general mortgages, it will begin the preparation of a plan of reorganization. There will be no assessment on the stock or junior bond issues. To take up the $32,000 of receiver's certificates, defray the reorganization expenses and provide funds for renewing bridges about $600,000 is thought to be necessary. This sum will be secured by the sale of new first mortgage bonds. The present securities will be rearranged so that the interest will be within the limit of probable earnings.

Shepaug, Litchfield & Northern.—The project to connect this road with the New York, New Haven & Hartford by building a line from the present southern terminus at Hawleyville, Conn, south about 20 miles to Saugatuck on Long Island Sound, is being discussed in Westport, Nor

walk and other towns interested. The line parallels the Housatonic for nearly the entire distance. The company's officers state that they will build the road if $100,000 is raised along the route. Meetings are being held to try and secure this amount. A new survey will be commenced next week.

Sparta & St. Genevieve.—This company has filed in Illinois a charter to build a road from a point on the main line of the Centralia & Chester, west of Sparta, to a point on the Mississippi River opposite St. Genevieve, Mo. The capital stock of the company is $80,000, and the principal office will be in Sparta, Ill.

Spearfish & Southern.—Incorporated in Dakota to build a road from Spearfish to a point on the Western line of Dakota territory, between Bear and Sand Creeks, a distance of about 25 miles.

Valley (Ohio).—At the annual meeting, held in Cleveland, Ohio, this week, it was expected that some official action would be taken, tending to show whether the reports concerning the transfer of the controlling interest in the stock were correct. No such action was taken, however. The reports are to the effect that an eastern syndicate, in which Andrew Carnegie is supposed to be interested, has secured control of the road, and that it will be extended south some distance to connect with a line to Pittsburgh, thus making the line a competitor of the Cleveland & Pittsburgh for through business between Pittsburgh and Cleveland.

Wheeling, Wellsburg & State Line.—At a recent meeting of stockholders in Wellsburg, it was reported that the right of way had been secured, substantially free, from the Ohio River at Wheeling, W. Va., to Canonsburg, Pa., about 30 miles. Engineers are now looking over the two routes proposed, and it will probably soon be decided which line to adopt.

TRAFFIC.

Traffic Notes.

The Railroad Commissioners of Missouri have ordered that the rates on wheat from Jasper County points to St. Louis, either by the St. Louis & San Francisco or the Missouri Pacific, be reduced from 20 cents to 16 cents (C. L.).

The question of car load rates on live stock in Missouri and Kansas, which have been the subject of several hearings and decisions by the State Commissioners, will be considered by the Inter-state Commerce Commission in a hearing at Jefferson City, Mo., May 6.

The Board of Managers of the Inter-state Commerce Railway Association have decided to allow the Chicago, St. Paul, Minneapolis & Omaha to put into effect rates from Northern Nebraska points on the Union Pacific and from Council Bluffs, to Duluth, the same as those from these points to Chicago.

At a meeting of the executive committee of the Trunk Lines Association on Wednesday of this week, it was resolved to reduce the mileage rates on private owners' refrigerator cars from 1 to ¾ cent per mile. The question of the ownership of live-stock cars occupied the attention of the meeting for a long time, and it was finally decided that no more live-stock cars owned by private individuals or corporations should be used over the trunk lines after May 1.

The Iowa Railroad Commissioners have adopted a revision of their live stock schedule, to take effect May 1. The 31-ft. car is adopted as a standard, and a 28-ft. car is rated as 90 per cent. of it. A 33½-ft. car is rated at 108 per cent. Minimum weights per standard car adopted are: Horses and cattle, 20,000 lbs.; hogs, 15,000 lbs.; sheep, 12,000 lbs. A 75 per cent. rate of fat cattle is adopted for stock cattle and feeders. Compared with the old rates these are slightly higher on cattle and lower for short distances on hogs.

The Old Colony has discontinued the ordinary season tickets between stations within ten miles of Boston, and has adopted instead transferable books containing coupons for 5 rides, 10 rides and 100 rides, similar to those used by the Boston & Albany. The latter road in making this change several years ago raised the rates for regular commuters, arguing that the transferable character of the tickets, by which the purchaser's family, making infrequent trips, traveled at very low rates, would offset the increase in the price paid by the chief user of the ticket. It is announced that the Old Colony rates for 100 ride tickets are 5 per cent. *lower* per mile than the former season ticket.

The proposed change in dressed beef and live stock rates by the Central Traffic and Trunk lines goes into effect May 1. The rates on cattle will be advanced to the basis of 26 cents per 100 lbs., Chicago to New York, with the option of free delivery within the lighterage limits of New York Harbor. No icing of cars containing dressed beef or provisions will be done free or paid for in whole or part by the carriers. The vote on the resolution in regard to private stock cars and mileage on individual refrigerator cars was not unanimous, and these questions require further consideration. The question of advancing dressed beef rates by the roads now charging 43¼ cents, Chicago to New York, to the basis of 45 cents was submitted to arbitration, and it was decided that, taking effect May 1, this advance should be made. These roads are the Wabash (Niagara Falls Short Line) and the Chicago & Atlantic, not members of the Central Traffic Association.

The Inter-state Commerce Commission.

The Commission issued on April 18 its decision in the matter of the status of the Grand Trunk Railway of Canada, under the law. It is by Commissioner Schoonmaker:

1. The provisions of the Act to Regulate Commerce apply to common carriers engaged in the transportation of passengers or property for a continuous carriage or shipment from a place in the United States to a place in an adjacent foreign country.

2. Such common carriers are subject to the provisions of the act in respect to the printing of schedules of rates, fares and charges for the transportation of passengers and property, the posting and filing with the Inter-state Commerce Commission of copies of such schedules, the notice of advances and reductions and the maintenance of the rates, fares and charges established and published and in force at the time.

3. Such common carriers are also subject to the provisions of the act in respect to joint tariffs of rates, fares and charges for continuous lines or routes.

4. The carriage of freights cannot be prevented from being treated as one continuous carriage from the place of shipment to the place of destination by any means or devices intended to evade any of the provisions of the act.

5. Under the provisions of the act the Grand Trunk is required to print, post and file its schedules of rates and charges for the transportation of property from points in the United States to points in Canada, and cannot lawfully charge, demand, collect or receive from any person or persons a greater or less compensation therefor, or for any services in connection therewith, than is specified in such published schedule as may at the time be in force.

6. It appears that the Grand Trunk transports coal and coke under a schedule specifying a total rate from Buffalo, Black Rock and Suspension Bridge, in the United States, to Hamilton, Dundas and several other points in Canada; that the published tariff rate for such transportation from the points named to Hamilton and Dundas is $1 a ton, but that it accepts a reduced charge, or allows a rebate of 25 cents a ton, in favor of certain consignees at Hamilton, Dundas and other points in Canada.

Held, that the reduced charge accepted or rebate allowed s in violation of the Act to Regulate Commerce, and unlawful.

7. The Inter-state Commerce Commission has authority to institute investigations and to deal with violations of the law, independently of a formal complaint, or of direct damage to a complainant.

In considering the complaints of George Rice, of Marietta, O., concerning rates and classification of oil in tanks and barrels, furnishing of oil cars by railroads, and mileage on the same, the Commission finds that all railroads are affected by the questions presented, and it has, therefore, notified about 150 companies to present evidence and arguments if they so desire.

Bill of Lading Conditions.

The Freight Committee of the Central Traffic and the Trunk Line Associations have decided that the following clause must be inserted in all through bills of lading and also in dray tickets and in shipping orders and receipts:

Not negotiable unless the word "order," unqualified except as herein provided, is written immediately before or after the name of the party to whose order the property is consigned. It is mutually agreed as follows: That this bill of lading is not negotiable unless the word "order," without any condition or limitation other than the name of the party to be notified of the arrival of the property at its destination, is written hereon immediately after the name of the party to whose order the property is consigned, and that when the word "order" is so written this bill of lading shall be negotiable, and must be surrendered before the delivery of the property.

It has also been agreed that the following notation be inserted on all way bills of property consigned to "order" or "notify:"

"To order of —— Notify —— to be delivered only upon presentation of the original bill of lading properly indorsed."

The following notification is to be printed on duplicate bills of lading in bold type and different colored ink from terms and conditions:

"Not Negotiable. Take notice that this is only a copy of a bill of lading issued by —— for the property herein described or referred to, and it is not itself to be regarded or construed as a bill of lading or a contract of any kind under any circumstances, but merely an acknowledgment that a bill of lading for said property has been issued."

East-bound Shipments.

The shipments of east-bound freight from Chicago by all the lines for the week ending Saturday, April 20, amounted to 41,940 tons, against 42,194 tons during the preceding week, a decrease of 254 tons, and against 48,129 tons during the corresponding week of 1888, a decrease of 6,189 tons. The proportions carried by each road were:

	W'k to Apr. 20.		W'k to Apr. 13.	
	Tons.	P. c.	Tons.	P. c.
Michigan Central	4,788	11.4	4,944	11.7
Wabash	3,882	9.3	4,442	10.5
Lake Shore & Michigan South.	5,507	13.1	4,366	10.4
Pitts., Ft. Wayne & Chicago	5,190	12.4	5,568	13.2
Chicago, St. Louis & Pitts.	6,259	14.9	6,279	14.9
Baltimore & Ohio	2,776	6.6	2,740	6.5
Chicago & Grand Trunk	5,833	13.9	5,526	13.1
New York, Chic. & St. Louis	3,742	8.9	2,513	5.9
Chicago & Atlantic	3,963	9.5	5,816	13.8
Total	41,940	100.0	42,194	100.0

Of the above shipments 2,328 tons were flour, 12,362 tons grain, 2,072 tons millstuff, 4,094 tons cured meats, 1,167 tons lard, 8,438 tons dressed beef, 1,345 tons grass seed, 927 tons butter, 1,403 tons hides, 120 tons wool, and 5,862 tons lumber. The three Vanderbilt lines carried 33.4 per cent., while the two Pennsylvania lines carried 27.3 per cent

Union Pacific.—Annual Report.

The annual report of this company for the year ending Dec. 31, 1888, is just published. The results of operations for the whole system for the year as compared with 1887 are as follows: The average mileage operated was in, 1888, 4,783.19 miles, and in 1887, 4,622.81 miles.

Income:	1888.	1887.	Inc. or Dec.
Earnings	$29,260,824	$28,557,766	I. $703,059
Expenses	$17,933,945	$16,616,761	I. $1,317,184
Taxes	1,231,420	1,050,971	I. 180,449
	$19,165,366	$17,667,733	I. $1,497,633
Surplus	$10,095,459	$10,890,033	D. $794,575
Income from investm'nts	916,216	1,030,552	D. 114,337
Proceeds miscellaneous land sales	13,532	15,904	D. 2,372
From trustees K. P. Consolidated mortgage, interest	.....	17,850	D. 17,850
Utah & Nevada Railway Co., surplus	23,999	17,891	I. 6,108
Ogden & Syracuse Railway Co., surplus	3,778	.....	I. 3,778
Total income	$11,052,982	$11,972,230	D. $919,248
Expenditure:			
Interest on bonds	$5,057,714	$5,134,566	D. $76,851
Other charges against income	1,362,601	1,331,372	I. 31,229
Sinking fund requirements, U. P. R.	588,585	587,670	I. 915
Sinking fund requirements, other companies	24,847	24,847	D. .01
U. S. requirements	1,134,394	1,205,656	D. 71,262
Discount and interest	148,902	160,153	D. 11,251
Discount on bonds sold, premiums, etc	106,963	113,490	D. 6,527
Land expenses and land taxes, U. D.	70,408	53,653	I. 16,755
Profit and loss	123,431	85,972	I. 37,460
St. Jo. & G. I., deficit	140,917	93,995	I. 46,923
Ore. Ry. & N. Co., deficit	349,118	18,083	I. 331,035
Cent. Br., U. P., deficit	342,019	161,629	I. 180,390
Mont. Union Ry. Co., one-half, deficit	9,695	55,774	D. 46,079
Total expenditures	$9,459,596	$9,026,860	I. $432,736
Balance	$1,593,386	$2,945,370	D. $1,351,983
		1888.	1887.
Per cent. of expenses		61.29	58.19
Per cent., including taxes		65.50	61.87
Gross earnings per mile		$6,117	$6,177
Net earnings per mile		2,111	2,356

For the Union Pacific road proper the results were:

	1888.	1887.
Gross earnings	$19,898,817	$19,546,089
Operating expenses	11,112,147	9,869,616
	$8,786,670	$9,676,473
Taxes	667,202	564,586
Net earnings	$8,119,468	$9,111,887
Per cent. of expenses	55.84	50.49
Per cent., including taxes	59.20	53.38
Miles under operation	1,824	1,824
Gross earnings per mile	$10,911	$10,716
Net earnings per mile	4,452	4,995

The following table shows the condition of the funded and floating debt of the entire Union Pacific system, Dec. 31, 1887, and Dec. 31, 1888, respectively:

	1888.	1887.
Funded debt in the hands of the public	$152,053,756.64	$147,004,611.29
Bonds of the U. P. R. Co. in treasury	861,800.00	586,300.00
Total	$152,915,556.64	$147,590,911.29
Net floating debt*	5,063,729.84	401,689.11
Total funded and floating debts	$147,851,826.80	$147,189,222.18
Miles of road (p. 102)	4,897.8	4,771.1
Debt per mile of road	$30,187.39	$30,850.17

*Excess cash and cash resources.

Some traffic statistics for the entire system are:

Average receipts per mile:

	1888.	1887.
Per passenger—cents	2.416	2.509
Per ton	1.403	1.572
" including coal	1.281	1.422
Passenger train miles	5,462,597	4,601,333
Freight " "	9,991,740	9,307,972
Average passenger journey, miles	78.14	78.29
" haul freight, miles	306.06	275.65
Ton-miles	1,669,289,817	1,490,004,636
Passenger-miles	278,381,266	262,913,074

The directors say: "Up to a comparatively recent date, your directors had hoped to be able, with the issuing of the present report, to resume the payment of dividends upon the capital stock of the company on a conservative basis; but the results of the closing months of last year, with the present outlook for the current year, would not, they feel, justify them in so doing. During four years prior to 1888 the surplus revenue from the operations of the entire system, applicable to dividends on the stock of the company, averaged 5 per cent. per annum. During last year, owing mainly to deficient crops in Kansas and Nebraska, which adversely affected all the roads operating in those states, the surplus revenue of the Union Pacific proper fell below the average and equalled 4.12 per cent. on the company's stock. During the year, however, the company was from time to time called upon to advance money to meet deficiencies incurred on account of leases and the inability of certain auxiliary lines, in which it owned a proprietary interest, to meet their fixed charges. The net surplus revenue of the system is equal to 2.61 per cent. on the capital stock of the Union Pacific Railway proper."

A revision of the contract with the Oregon Short Line is recommended, by which joint traffic to and from the Oregon Short Line and its branches shall be divided on the basis of 1¾ miles on the latter road to one on the Union Pacific. This is practically the basis on which the traffic has heretofore been divided, but, according to the terms of the original contract, the division should have been on a straight mileage basis.

"Your directors have decided that it is desirable to merge into one company, as soon as can legally and conveniently be done, all the railroads west of the junction point of the Oregon Short Line with your main line, owned or controlled by the Union Pacific through state or territorial charters. These companies are six in number, to wit: Oregon Short Line Railway Co., Utah & Northern Railway Co., Utah Central Railway Co., Salt Lake & Western Railway Co., Utah & Nevada Railway Co., Ogden & Syracuse Railway Co.

"The above corporations own or control, in the aggregate, 1,436 miles of road. The gross earnings of the roads composing the proposed consolidated company aggregated in 1888 $5,819,000. The operating expenses and fixed charges were $5,231,000, exclusive of loss in the operation of the lines of the Oregon Railway & Navigation Co. The forming of this consolidated company will not only greatly simplify the complicated system owned by the Union Pacific, rendering possible a more effective management, together with many economies, but it is believed that it will result in establishing at the western terminus of your road a vigorous, solvent corporation having a credit and financial standing of its own, and earning a large income, a portion of which it is reasonable to expect may be applicable at no remote time to the payment of dividends on its stock. A controlling interest in the stock of the consolidated company will be held in the treasury of the Union Pacific, and harmony and co-operation between the two will, therefore, be assured.

"In their last annual report, your directors, in referring to the proposed joint lease of the property of the Oregon Railway & Navigation Co. by the Northern Pacific and Union Pacific railroad companies, expressed the belief that all difficulties would be removed at an early day, and that the lease in question would be ratified by the parties interested in it so as to take effect from the 1st day of July then next ensuing. Fresh obstacles in the way of the execution of the proposed instrument subsequently developed. The popular opposition to it on the part of the people of Oregon—more especially the city of Portland—assumed a more pronounced shape, and its ratification by the directors of the Railway & Navigation Co. was enjoined by the courts. At the same time the construction of certain competing lines in the region reserved under the proposed instrument for the occupation of the Oregon Railway & Navigation Co. was actively pursued. If the competing lines in question were built and developed it was apparent that they could inure only to the benefit of the Northern Pacific. As lessee of the Oregon Railway & Navigation Co. the Oregon Short Line, therefore, found itself placed in the difficult position of being bound by the terms of a proposed instrument which meanwhile was not binding on the other party to it; competitive construction, most damaging to the Oregon Railway & Navigation Co., was being pressed forward, while that company was, by the terms of the proposed lease, debarred from making good the loss thus suffered by similar construction in other directions. Accordingly, on the 2d day of June, the directors of the Oregon Short Line Co. formally reconsidered their approval of the lease. Active construction in the interest of the Navigation company was then undertaken, and during the summer and autumn a bridge was constructed across the Snake River at Riparia, and some 280 miles of road were either wholly or partially built."